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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION

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Forthcoming Events

MARCH 7-8

Institute of Metals:—Annual general meeting, 10 a.m., in the Hall of the Institution of Mechanical Engineers, Storey's Gate, London. Annual dinner and dance, 7 p.m., at the Trocadero Restaurant, Piccadilly Circus, London.

MARCH 9

Institute of Metals (Sheffield Local Section):—Meeting at the University at 7.30 p.m. "Nickel-Chrome Plating," Paper by Frank Mason.

MARCH 14

Institution of Welding Engineers:—Meeting at the Institution of Mechanical Engineers, London, at 7.45 p.m. "The Collation of Research and Application for Welded Fabrications," Paper by H. W. Hawkins.

Institute of British Foundrymen

MARCH 9

Middlesbrough Branch:—Meeting at the Cleveland Scientific and Technical Institute at 7.45 p.m. "Steel Castings, with Special Reference to the Tropenas Process," Paper by John E. Mercer and D. K. Barclay.

MARCH 10

Scottish Branch:—Annual general meeting at the Royal Technical College, Glasgow, at 4 p.m. "Coke Research," Paper by Wm. Davidson.
West Riding of Yorkshire Branch:—Meeting at the Technical College, Bradford, at 6.30 p.m. "Porosity," Paper by E. Longden.
East Midlands Branches:—Annual dinner at Loughborough.

MARCH 14.

London Branch:—Meeting at Charing Cross Hotel, W.C.2, at 8 p.m. "Potentialities of Cast Iron," Paper by A. B. Everest.

The Reorganisation Scheme

The pronouncements on the outcome of the meeting of the members of the National Federation of Iron and Steel Manufacturers were not very spectacular and pleased nobody. Actually a sub-committee was appointed consisting of Sir Frederick Mills, M.P., Mr. C. U. Peat, M.P., and Sir William J. Larke to prepare a draft agreement for submission to a later meeting, and the articles of the Federation are to be changed in order that its activities may be increased. These activities will probably include—though its plans are, of course, secret—a quota system of production; control of sale prices; a levy on home sales to promote the export trade; and the creation of a body of experts, under the control of the Federation, to assume responsibility of export sales of all sections—this would mean, of course, widening the scope of the British Steel Export Association. It has also been rumoured that the Federation will control all imports of iron and steel during a fixed period of years. Schemes of rationalisation are hinted at, which will involve the closing of redundant works, and concentrate production on the more efficient establishments.

The reaction of the Government to all this is fairly obvious. It will be guided by public opinion, and this is overwhelmingly in favour of the continuation of duties on imported iron and steel, but when the closing down of existing works is envisaged, then there is bound to be an outcry, as even the most inefficient is capable of making profits and adding to the material wealth of the country under boom conditions. All this reorganisation is meant to cope, not with the existing conditions of slowly expanding markets, but it is looking ahead to minimise the dangers and distress to be associated with depression—that is, when production overtakes consumption. The steps which were taken at the meeting did not represent the unanimous feeling of the meeting, and the opposition was rumoured to have come from the important pig-iron manufacturers and certain of the steel finishers.

This does not give much hope of the immediate inclusion of the ironfoundry industry within the scheme, and this industry may have to wait until such time as the steel end has settled down to the new conditions. In the meantime, every foundry owner should make contact with his appropriate employer's association, in order that when the time is ripe for action the diverse interests of the foundry can be adequately represented.

The Foundry Degree Course

The organisation of a degree course in foundry practice within the metallurgical department of Sheffield University is proceeding apace. The Committee of the Institute of British Foundrymen charged with the duty of advising Prof. Andrew and the University authorities has been strengthened by important additional personnel, which now includes Sir Robert Hadfield, Dr. Pickard-Cambridge, the Vice-Chancellor of the University, Dr. W. H. Hatfield, and Mr. J. G. Pearce, the director of the British Cast Iron Research Association. Appeals are being made to the firms constituting the foundry industry to make an annual subscription for seven years. In sending subscriptions firms can deduct income tax and be credited with the full amount, as the University authorities will reclaim this from the Treasury. The enthusiasm aroused is considerable, and subscriptions have been received from foreign foundry owners who recognise that the highest form of foundry education given in Great Britain will help internationally to enhance the status of the industry. Surely no British foundry owner can now remain unappreciative of a scheme which has had the practical support of foreign foundrymen.

Lecturing in Sheffield last week, we showed that from our extremely wide contact with the foundry industry, we were convinced that a fresh type of training is required to meet the new conditions in the industry, as what has been given in the past leads to the divorce court instead of the marriage altar. In other words, members of the staffs in all foundries know too much about either foundry technique, metallurgy, or mechanical engineering, but insufficient of all three to make really competent executive officers capable of welding these three essential branches of knowledge into one harmonious whole, so necessary for the economic conduct of the modern foundry establishment, be it large or small. There are, of course, some brilliant exceptions, but these are insufficient to ensure the proper efficient conduct of industry in the future. The British Cast Iron Research Association and other bodies are turning out wonderful research work which requires interpreting by a mind which has a knowledge of mechanical, engineering metallurgy, and, above all, foundry technique. During the next few days the various firms will be asked to table their promises of support, and we ask them to view the scheme as generously as ever possible.

C

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents]

Steel Castings

To the Editor of THE FOUNDRY TRADE JOURNAL

SIR,—Since the Admiralty seeks to reduce the weight of their castings to a minimum and expects perfection, every care and precaution must be taken by all concerned. The designer and others must therefore do their utmost to help the foundry in this. With steel castings of very thin section air and gas locks are very often hard to overcome, whilst tears and pulls are likely to be more frequent because the steel must be run into the mould as hot as possible, which involves increased contraction during solidification. Solidification is the more rapid in castings of thin section, and if uneven sectional places exist in the casting and no effort be made to create uniform solidification conditions, then trouble will ensue. In castings of the type under discussion, chilling is better than bracketing, because where the latter is used and the casting is of thin section, the casting solidifies as quickly as the bracket, thereby making the brackets a further source of potential trouble instead of being an aid. Chilling certainly involves more time and care, but the result justifies the effort. Undoubtedly a foundryman who makes a keen study of his job is the best judge of the probable result as soon as he sees his pattern, drawing, or lastly the mould, before being finally closed. It is often said that unless great care is taken in the foundry the efforts of all the others—the designer, patternmaker, and the metallurgist are wasted. This could be paraphrased to " If great care is not taken by the designer, patternmaker, and the metallurgist, the foundryman's efforts are wasted." The essential factor is obviously co-operation with all parties concerned. If the Admiralty desires castings of much thinner design to reduce weight, yet sufficiently strong to withstand high pressures and temperatures, the only possible solution is to use " alloy steels " in the place of the ordinary plain-carbon steels. Alloy-steel castings would certainly give good results under test, and although the cost would be higher they would prove to be the more economical in the end, because of their efficiency. Alloy steels demand extra precautions in heat-treatment because of the great variation of properties that can be obtained. Would a chromium-vanadium steel meet requirements where weight has to be reduced yet temperature and pressure has to be the same where thicker sections had been utilised before? Possibly it would, because chromium decreases the tendency of crystalline growth and therefore gives the steel a far finer grain. Combined with nickel or vanadium, this element gives the strongest and most durable steels which can easily be machined if necessary.

The following table by Sir Robert Hadfield gives the mechanical properties of such a steel as :—

	Per cent.	Per cent.
Carbon content	0.4	0.25
	Deg. C.	Deg. C.
Steel quenched at	870 in oil	850 in water
Tempered at deg. C.	650	650
Elastic limit, tons per sq. in.	45	50
Maximum strength tons per sq. in.	62	54
Elongation (percentage) ...	20	27
Reduction of area (percentage)	57	70

Use of Vanadium

Vanadium is considered to be a powerful deoxidising agent and that it increases the molecular cohesion and imparts a finer and denser structure than in an ordinary carbon steel. Vanadium also promotes the even distribution of carbon and prevents constitutional segregation. Castings such as valves are undoubtedly very important parts in machinery, and if cast in plain carbon steels may suffer very quickly from corrosion, a very important factor, which should not be overlooked because of the cutting down of the thickness of the walls of the valves, but the use of alloy steels would almost eliminate this difficulty.

In nickel steel, the nickel has a beneficial effect by making the structure finer and more homogeneous. It is said nickel hinders the segregation of carbon and the other elements, and without a doubt segregation of carbon is very often responsible for " hard spots " found in steel castings. A nickel steel containing from 2 to 4 per cent. nickel and carbon 0.2 to 0.5 per cent. is used for marine forgings, guns, frames, large bridge spans; also it is largely used for the manufacture of tubes of high grades which are cold drawn. The uses of this alloy steel alone recommends it for any casting which demands quality of material, reduction of weight and homogeneity, etc. In chromium steel of 1 to 2 per cent. chromium gives a steel of great hardness and decreases the tendency of crystalline growth, giving the steel a dense fine grain, a desirable steel for such work as valves. Chromium steels are responsive to heat-treatment, for chromium intensifies the sensitiveness to quenching and also reduces the liability to fracture. It increases the elastic limit and gives maximum strength without appreciable loss of ductility. Steel of this description gives a foundryman a better steel to handle than a very low plain-carbon steel, because the milder the steel the greater the difficulty of getting rid of blowholes, pipes and segregations.

Gas Evolution and Oil-Sand Cores

The fact that so many different methods were used to try and achieve perfection in the production of the casting which was under discussion goes to show that it was not so easy to produce as it seemed. There were questions of the sands for mould or core, the best method of running and the feeding of the casting. The porous places found in the casting were due more to gases generated during casting operation than from any oxides. Discussions on oil-sand cores have disclosed diverse opinions, and some say that if an oil-sand core is perfectly dried, then no matter what metal is being used, even though it completely covers the core, no eruption whatever takes place. Thus, when the opportunity has occurred, I have looked down feeding heads, where oil-sand and natural-bonded cores blackleaded or painted have been in use, to ascertain what actually does take place. Also, for experiment, when there has been any surplus steel or metal, I have utilised it to cast small open-sand blocks, some with oil-sand, others with natural-bonded cores inserted, some with the cores horizontal, others vertically, with vents open at both ends, and others cast vertically with the core completely covered excepting the bottom-print end. The only conclusion arrived at was that the oil-sand cores created far more agitation than the natural-bonded cores.

Suspended Castings and Tears

To run castings such as were under discussion requires casting so that the gases from the core can get away through the vents and not through the steel. To do this with such castings and using an oil-sand core demands casting it on its end or on a " bank," and, if cast on end, creates the problem of the possibility of its " hanging itself." By this I mean, any casting where at each end is the least obstacle to hinder contraction from both ends during solidification, it is almost certain to create pulls or tears. Castings which have found opportunity to contract from the bottom upwards, and have unfortunately been tied at the top by the design of the casting or some irregularity, probably in the feeding head or even the runner, hang themselves, creating tears and pulls in the lower half of the casting. These are created by the weight of the bottom half of the casting immediately asserting itself after contraction commences. As an example, take a casting which has been cast on its end with the feeding head enlarged, or the same casting where the feeding head is, or should have been, a continuation of the casting, such continuation being made by strickling out and not being done as carefully as it might have been, thereby causing irregularities. Another example is given by an ingot with a feeding head, wherein the ingot cast quite satisfactorily, but the head, unfortunately, has been caused to " bleed," and a small amount of molten steel has run between the ingot and the ingot mould. Thus, when the ingot and the ingot mould contracted, it fastened the upper part of the ingot. In many instances this will cause cracked ingot moulds, but the fact remains that, when the lower half of the ingot starts to contract, the weight of the ingot creates a tear or pull. This is just an explanation of " hanging itself." This also has been known to happen by small pellets of steel or small pieces of scrap getting between the ingot and the ingot mould, thereby " wedging " the ingot from the top. This " hanging up " can be partly overcome when making castings under consideration by providing means, when making the mould, for getting away quickly any sand or other obstructions, or by having the boxes containing the casting turned to a horizontal position from the vertical as soon as the feeding head has set, and then covering the casting again as quickly as possible with the hot sand to keep the cold atmosphere away, and thereby preventing any more unequal cooling than can be helped. This method would be preferable to getting the casting out of the mould and placing immediately into an annealing stove. Getting the core out would be of no advantage with this casting, assuming that no hindrance to contraction would take place from the core.

Totally Enclosed Cores

However, to cast such a casting on a " bank," that is, at an angle according to the length of the casting, involves the core being covered by the steel gradually upwards and not all at one moment as if cast dead level. This way of casting certainly gives the gases a far better chance of getting away before the mould was actually full through the vents and not through the steel, also by casting this way makes possible one feeding head on the highest flange, and this cut on the outside of the flange, then directly behind this flange brackets, could be used to advantage. Whistlers would only be necessary through the other flanges, so as to not create any air or gas locks, and gravitation would feed the casting at the lower end upwards. The runner could be at the lower end and run the steel upwards, but I should prefer the runner in the feeding head. By having one feeding head at the highest point of the casting, " hot spots " would be to a great extent eliminated. With the extra thickness of metal created with the flanges near the centre of the casting, and the feeding heads which were used, without doubt created a very hot spot in the centre of the casting, the very place where contraction started, would be the first to be " pulled." To treat this mould when cast as the one cast on its end would certainly tend to give good results, which all foundrymen aim at. From practical experience, one has found that, particularly in castings of the type under discussion, moulds

(*Concluded on page* 156)

Patternmaking

By F. C. Edwards

(*Concluded from page* 133)

A Pipe Barrel Pattern

A somewhat different type of pattern is illustrated in Figs. 11 to 15. The casting (torn to facilitate portrayal) is shown in Fig. 11. The special feature of this casting is the elbow, Q, which, in conjunction with the midriff, R, presents one or two interesting moulding problems. It will be seen that the midriff forms a "dead end" to the pipe barrel, and thus prevents the adoption of the double-end bearing for the main core. It should be noted that the pipe was required to be petrol-proof. This meant that arrangements had to be made for anchoring the main core without resorting to chaplet support. The close proximity of the gap, S, in the base made it inexpedient to mould the job with the joint through the elbow.

The actual method adopted was as follows: The pattern, seen in Fig. 12, was jointed through the centre, to mould upside down to that shown. The inside elbow core was formed on the main pipe core, as seen at T (Fig. 13)—which shows one-half of the corebox. The outer end of the elbow core was formed as a "Tee" piece—U (Fig. 13). In order to insert this tee piece into its coreprint, V (Fig. 12), the coreprint, W, was employed—the core for which was made out of the corebox shown in Fig. 14. This core served as the main anchorage medium for the elbow end of the pipe, besides forming the undercut portion of the outer part of the elbow.

In coring up the mould, the recessed surface (X, Fig. 14) of the anchoring core is linked up to the neck (Y, Fig. 13) of the main core, and the two are inserted into the mould together. Two long nails driven through slots previously made in the anchor core into the body of the mould effectually holds down the main core. A little finishing, of course, is necessary where the anchor core joins the green-sand mould. For the base of the job, a core is made from the box seen in Fig. 15 (torn to facilitate portrayal). It should be noted that an outward taper—Z—is given to the base coreprint. This is not of immediate assistance to the moulder, but, reflected in the corebox, at Z (Fig. 15) facilitates core withdrawal. Another welcome feature in the eyes of the moulder is the absence of a "set-off" where the coreprint meets the flange. As a general principle, the "sharp corner" of sand should be avoided wherever possible; such corners are easily disturbed as the core is being lowered in position—not to mention the greater risk of lowering the cope over the core—and the molten metal does the rest! In the case seen in Fig. 12, the generous outward bevel, Z, forming the "key-stone" coreprint, is found to be an adequate locating medium for the core.

It may here be of interest to mention that the last example, owing to increased orders for castings, was converted into a metal pattern. This meant increasing the overall length of the pattern, to the extent of the shrinkage taking place in producing the iron pattern from the existing wooden one, and adding $\frac{1}{16}$ in., for contraction, all round the base. Stripping and carrying plates were made for machine moulding. No alteration was made to the coreboxes.

Metal Patterns

Metal patterns, of course, require similar attention to moulding principles as wood patterns. The use of the stripping plate, however, reduces the need for excessive taper. Where comparatively heavy coreprints occur on metal patterns, it is better to cast the outside shape in its entirety—that is, as a shell—and block up the interior with wood, rather than remove the coreprints altogether and subsequently fit wood prints. In this way, the shape and position of the coreprints is assured: it is part and parcel of the casting, and runs no risk of future displacement.

Importance of Varnish

By no means the least important part of a pattern's equipment is its coat. Here the "nudist colt" cannot be too strongly deprecated! Every pattern worthy of the name deserves painting. And yet, "handsome is as handsome does," for paint, in patternmaking, has a threefold function: it protects the wood from mould moisture; it gives surface smoothness; and it imparts instruction to the moulder. The examples already referred to in this Paper of the deleterious effects of mould moisture on wood

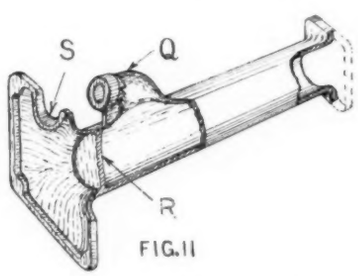

FIG.11

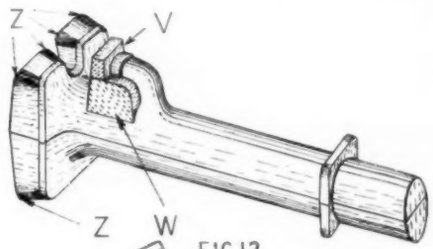

FIG.12

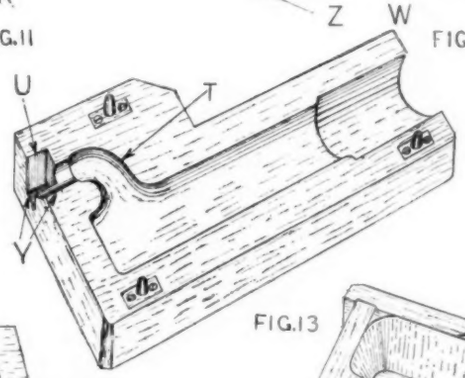

FIG.13

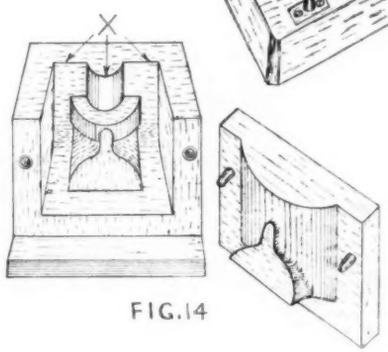

FIG.14

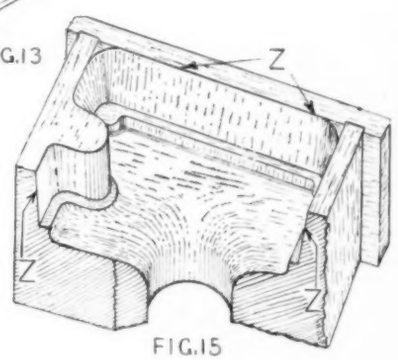

FIG.15

sufficiently emphasise the first-mentioned need of paint. And the fact that a pattern has to be withdrawn from the mould—or (a weightier reason) the mould withdrawn from the pattern—is, again, sufficient emphasis on the need for the second-mentioned purpose of paint-smoothness. As a medium of instruction to the moulder, distinctive painting is, of course, invaluable. Coreprints, and those parts of the pattern where the core will "cut through" in the casting, should be of a different colour to the parts which are to form the casting. Machined faces, again, should be clearly indicated. Such indications will often determine the "way of moulding," the position of risers, as well as the gating of the job. Those portions of the pattern not required to be produced in the casting—strengthening bars, battens, etc.—should be ornamented with the well-known "zebra stripes." The absence—or even the ambiguity—of such instructions has brought many a casting to the scrap heap. In the case of the frail pattern, indeed, it may not be amiss to remind the moulder, in legible, painted script, that he "should temper the wind to the shorn lamb"—or some such "arresting" phrase!

Pattern Colours

Whatever kind of paint is used, it should be capable of drying, say, in a few minutes. Patternmaking is not, usually, a leisurely occupation. As soon as patterns are completed—often, indeed, before they are commenced—there is an urge to "get them into the sand." Paint, therefore, must dry hard, and quickly. Shellac varnish satisfies these conditions. The colouring powder should be finely ground. Two colours are sufficient for all purposes. Since distinction is the aim, yellow chrome and spirit black serve admirably. The body of the pattern may be yellow and the coreprints black. The machined surfaces should be indicated by "M" or "machined."

Apropos of pattern colouring, a recently-issued British Standard Specification (No. 467—1932) contains a scheme for the marking and colouring of patterns. The object, presumably, being to identify the metal of the casting from the colour of the pattern. The colour chart places metals in two categories: "iron and steel," and "non-ferrous." The utility of this specification is extremely problematical—if not precisely *nil*. Of what practical use, for instance, are three colours—as suggested by the specification—as a means of differentiation between the vast array of metal mixtures in common use to-day? "Iron and steel" may mean: "light, general" cast iron, "heavy, general" cast iron, "cylinder" cast iron," steel-mix, malleable iron and a host of other variations of Fe—not to mention the innumerable different classes of steel. "Non-ferrous," again, may mean: Brasses, gunmetals, bronzes, aluminium alloys, white brasses, babbit

metals, magnesium alloys, zinc-base alloys—with a legion of others!

The specification is further stultified by the fact that it is no uncommon thing for castings to be requisitioned off patterns originally made for another kind of metal. Aluminium castings, for example—to secure lightness—are made from patterns which are ordinarily used for iron castings. Steel castings, again—to secure an accession of strength—are requisitioned off patterns made, originally, to produce iron castings. In such cases—and they are not so infrequent as to be negligible—the specification could only be met if the pattern in question possessed the chameleonic power of changing its coat to suit the exigencies of the situation!

The most serviceable link between pattern and metal is found in the very simple practice of giving each pattern a distinctive number—preferably in raised characters—and quoting this number on the casting requisition form. The moulder reads, say: "One poise casting, pattern No. B34, metal, light general cast iron." Another requisition may read: "One poise casting, pattern No. B34, metal, aluminium." Here there is no possibility of confusion. It will be understood, of course, that in all cases where patterns are used for metals of different contractions, the patternmaker will suitably adapt the pattern. In small work, no alteration may be necessary.

Numbering Forms

"Numbering" forms the last phase of patternmaking. Pattern identification should be simple, speedy and certain. "Wrong pattern given out" is one of the worst of many reasons for scrap. This may be the fault of the pattern storekeeper, or the ordering department may be to blame, but it should rarely—if ever—happen. Successful works management—like the control of an army in the field—largely hinges upon the facility with which orders are interpreted. An order should never permit of more than one interpretation, and should immediately convey to the executive concerned the requirements of headquarters. The fact that this "easily-digestible food for action" may entail difficulty in its preparation must not be permitted to militate against simplification. Such difficulty, indeed, is both proof and justification of the policy of simplification. Surely, where doubt is likely to arise in the process of translation, it is better dealt with at the source from which the order emanates than at a subsequent stage!

In the well-ordered foundry, castings are made from patterns each bearing its own particular mark of identification. This mark is entered in the patternstores register, or card system, with the number of the locker in which the pattern will be kept when not in use. Whenever a casting is required, the identification mark is specified on the order received by the pattern stores. This stores is usually common to all the various departments of the firm—that is, one in which all the patterns for every department are housed. Since many castings are required the same day as the order is received, it is essential that the storekeeper should be able to locate the required pattern, or patterns immediately.

With the pattern stores common to all departments, then, one may not unfairly assume that each ordering department—whether of workshops or drawing office, is more conversant with its own requirements than the pattern stores could be expected to be. Each of the former, moreover, handle but a fraction of the pattern orders dealt with by the latter. The requisition of one pattern means, to the pattern storekeeper, one pattern to be located from a collection of many thousands. One should bear in mind, again, that patterns have not only to be given out, but they must also be collected from the foundry and returned to their place in the stores.

Here lies the key to the type of pattern identification most likely to lead to efficient handling. The system adopted, whilst serviceable, of course, to the ordering departments, should especially conduce to the speedy and certain location of the pattern required. In the language of chance (which seems to operate here occasionally), the dice should be loaded in favour of the pattern stores.

Location of Patterns

Now, location—speedy location, at least—implies an easy recognition of the thing sought. As a general rule, therefore, the men whose duty it is to serve out and collect the patterns should be able to trace many of them merely by the mental picture reflected by the identification mark—without referring to the register. That is to say, although one may obtain from the register the locker number of any pattern, advantage will accrue, in the way of speed and general economy, by the adoption of a method of identification in which memory is given a chance to work gratuitously. In this way, the wear and tear of books, time, and wages may be saved. The slogan should be: "A personality for every pattern!"

It is a well-known principle of mnemonics that memory very largely functions by the "association of ideas." Our earliest "cultured" ancestors instinctively sensed and applied this principle in their "Picture-writing." The main difference, by the way, between what is called the "civilised" and the "uncivilised" mind lies very largely in the fact that the former has brought the crude, picture-writing of the latter to a very high and complicated pitch of perfection. It may here be of interest to recall that the peculiarly picturesque nature of the Chinese language enabled Confucius (born 551 B.C.) to express the "Golden Rule" in one character, which we may translate in English by "Reciprocity." The ideogram is composed of two other characters, one denoting "heart" and the other —itself composite—denoting "as"; that is, my heart, as, or in sympathy with yours.

It is also pertinent to mention that our barbaric ancestors did not employ cyphers. They preferred pictures to mathematics. Their method of counting (still extant among our less-advanced brethren) being: "one," "two" and "a great number." And the "great number" appears to have been correctly registered as a picture on the mental retina of the savage.

Now, applied to the question of pattern identification, the foregoing points to the advisability of coupling, with the specific allocation of cyphers, a generic letter. This letter would have the effect (to continue the picture phraseology) of projecting on the pattern-storekeeper's mental screen the category to which the particular pattern belongs. The first step (proverbially difficult) to recognition would in this way be secured. The generic letter may either refer to distinct classes of work or to departments. In any case, they would afford considerable assistance to the pattern-storekeeper.

The author makes no apology for devoting so much attention here to the question of pattern identification. It is the last operation on the pattern; but it is certainly not the least in importance. As a postscript, it may be observed that the registration of Treasury notes and motor vehicles is on the lines above enunciated. The most "catchy" advertisements, again, use this method. The system works. And, lastly, the present year will, in the æons of ages to come, be referred to as: A.D. 1934.

Conclusions

This Paper began by postulating the pattern as an intermediary between design and casting. The note will serve to end upon. It sounds the patternmaker's "charter of liberty": liberty to create, to invent and originate. Translating two-dimensional design into a three-dimensional moulding agent can never become a routine job. Such translation essentially demands the interpretative flair of the linguist, plus the pioneer's urge for an ever-better way. Here is scope for genius, as defined by Dr. Johnson: "A mind of wide, general powers accidentally determined in some particular direction." The facile reading of blue-print; the mental picture of the casting; questions galore; to core, or not to core; how best to mould the job—with special reference to jointing; the imperceptible metamorphosis from the naked casting to the fully-accoutred pattern; then, grappling with powers of construction—to secure service strength and checkmate warping; into the realm of action: the ambidextrous manipulation of tools—where kaleidoscopic adaptation of force and direction uncannily suggests deep, mutual affection, and proves the perfect co-ordination of hand and brain! This—with interludes and variations—is patternmaking. Whether its pursuit is, to the patternmaker, inspiring music or a mournful dirge, depends entirely upon himself. He may make it (to quote Prof. T. H. Huxley's reference to man's life in general)—either a funereal march or a triumphal procession!

In conclusion, the author wishes to express his thanks to his employers—Messrs. W. & T. Avery, Limited—for their kindness in connection with this Paper.

DISCUSSION

MR. J. F. GREENWAY, proposing a hearty vote of thanks to the lecturer, said that he had obviously taken account of the difficulties of the foundryman and the moulder, and had shown he was possessed of true foundry sense. The small points in the finishing up of patterns counted a great deal in the foundry, and Mr. Edwards had given them food for thought in this direction. Mr. W. James, in seconding, urged that the Paper ought to be circulated among employers to show what patternmaking was. Many patterns were constructed contrary to the plan Mr. Edwards advocated, which was unfortunate for the foundryman. In too many cases the idea was something cheap, ignoring the practical aspect of how the moulder was to produce the casting. Sometimes patternmakers put in a lifting plate contrary to the method of moulding. He considered that patternmakers should spend six months in a foundry in order to realise the practical difficulties the moulder was up against. The motion was carried most cordially.

The BRANCH-PRESIDENT (Mr. E. J. Lewis), referring to the bedplate spoken of, said that in patternmaking of the description cited most designers liked to put a fancy bead round it. To construct a pattern with a half-lap joint and then cover in as shown on the slide would be difficult. In such cases of a fancy bead he thought the usual method was to make a master pattern, and cast a light metal frame and cover in round that. This plan imparted strength, stopped expansion and contraction from the pattern point of view, and held the pattern straight. Admittedly, it was something expensive, but taking the requirements of 1,000 to 3,000 castings mentioned by Mr. Edwards, this extra expense would not make much difference to the ultimate cost of the castings. He thoroughly agreed that prints should be cast as part of the pattern. But he himself always extended any prints outside so as to lighten out the job. Mr. Lewis instanced a metal pattern ⅜ in. thick, and said that instead of using a print the ultimate size of what it was to be on the job, he cast the print on the metal pattern and then extended another one outside it, making a rough corebox to ensure the print being on the metal pattern which he was making.

Regarding the painting of patterns and rushing them into the foundry to "get one off," he was dead against painting when patterns went straight to the foundry for moulding. In such cases they were bound to get a sticking of the sand and a dirty mould. The best plan in an urgent job was to send the pattern back for painting and finishing after the rush casting was done.

XUM

Varnishing and Camber

MR. W. JAMES considered it possible to varnish a pattern so that mould moisture became a secondary consideration. By applying a number of coats of good varnish, any damage from mould moisture became almost negligible. In making tooth wheels from a pattern 5 ft. in dia., he had no trouble owing to the use of a good strong varnish of sufficient coats. Camber was a subject which he found few knew much about. In making handrails to fit on the top of square rods —they were 9 ft. long—he suggested an allowance of $\frac{1}{8}$ in., as the rails had to be dead straight. The foreman stood out for $\frac{1}{4}$ in., so they split the difference. Difficulties arose; in the first five or six not one was straight. He subsequently learned that the usual attitude had been not to recognise camber. As Mr. Edwards had a good deal to do with flat material, perhaps he could enlighten them further as to camber. Mr. James added that he could confirm what had been said in praise of plywood.

The Way to Make Bed Patterns

MR. J. B. JOHNSON, as an old patternmaker, was glad that so many members had turned up to hear so eminently practical a Paper. He remembered a set of patterns being forwarded to his firm's foundry for a gas engine with a long bed. This bed was made exactly as the lecturer illustrated in Fig. 2. It lay in the sand all night, and the air was "blue" next day when efforts were made to get the pattern out. The real common-sense way, as pointed out, was to carry the sides down to the bottom. Thus, this trouble was avoided. Elementary points were important in practice; small things which were necessary, if ignored, only brought trouble and waste. He thought it advisable that a patternmaker should have some knowledge of foundry work. The suggestion of six months' tuition and work in the foundry might be improved upon; they might require patternmakers to work off some of their own patterns. Recently he had been casting some large plates 9 ft. by 8 ft. He checked the pattern over on one side, and it stood up very well. He did not attempt any striking-off of the bed, nor bedding them in, and good castings resulted. It was essential that in the foundry they should see that their tackle was right, and this ensured good castings and lengthened the life of their patterns.

Pattern Colour Specification

MR. G. M. CALLAGHAN believed he was correct in saying that a large percentage of the troubles of anyone managing a jobbing foundry could be put down to the patterns; either they were not right on entering the foundry, or were not right when they were worked off. A casting was made and went to the machine shop, being placed either on the machine table or in the lathe. It was carefully examined in a more microscopic way than was the pattern when drawn out of store. For measuring purposes as between casting and pattern he preferred to use the callipers and rule himself, because he had found engineers and patternmakers not particular to $\frac{1}{16}$ in. in measuring, and if a waster was made, it came back as the responsibility of the foundry. Patterns, if faulty, should be corrected before the moulder had to work them off again. He was not sure that two colours for painting were sufficient. A pattern ought to show which was metal, which was coreprint and machine face; and also where loose pieces fitted, as well as where pieces should be stopped off. The little pamphlet which Mr. Edwards thought of no value was, he considered, rather useful if everybody adhered to it; but they did not.

How Inferior Varnish Hinders

Different mixtures were used for painting in various pattern works, and he was faced with many patterns which seemed to have been painted with treacle. He did not think patternmakers realised the tremendous suction and pull required to release some of the patterns in big jobs. In one marine cylinder job of $7\frac{1}{2}$ tons weight the crane used registered 15 tons in pulling out the pattern. Some patterns which had been rammed up some weeks were quite sticky. He had known patterns which had been varnished which were definitely sticky after being in the sand for some time; these were on big jobs. One little refinement came under his notice some years ago which worked very well in connection with coreprints on pipes, and he believed few patternmakers were aware of it. He had used it very successfully, and illustrated his point on the blackboard. This was a small fillet round a pipe print against the flange, which prevented the core from breaking away the corner of the sand; the core did not, as he showed, touch the top part at all.

Pattern Sketch Usage

MR. W. J. GARDOM remarked that the specification in regard to marking patterns was actually recommended by the Institute, and while he agreed with the lecturer's criticisms, he thought it would be more satisfactory if patternmakers were to try and keep to the specification. One thing which the Committee which considered the matter recommended was that the contraction of the metal should be stamped on all patterns so made, which would meet Mr. Edwards' point in that respect. Marking of patterns was very important. One firm with which he was connected made a sketch of every pattern and gave it the original number. On the blue-prints of the parts issued there was noted any question of cores and any difficulty and the price. The percentage of scraps from the last order was recorded also, so that at a glance full information was available.

MR. J. F. GREENWAY, referring to the illustrations of releasing the core from core boxes, suggested that bolting would be a simple and convenient method, and said the screw holes would not become enlarged.

Taper Difficulties

MR. G. W. BROWN thought the supposed traditional feeling between patternmakers and moulders was exaggerated. However, it was exasperating to find that, while for a 6-in. deep job a patternmaker would allow plenty of taper, when it came to a matter of $\frac{1}{8}$ in. deep, the patternmaker seemed to forget all about it. Now suppose a patternmaker was arranging a corebox and print, a discrepancy of $\frac{1}{8}$ in. was nothing to him. He sent the box in with that discrepancy and caused endless trouble; whereas, if he took a little more care, he could eliminate much petty trouble which the moulder had to face. He recognised that it was a responsible job and that the patternmaker must take the initiative. It was not always possible for him to co-operate with the moulder, and some consultations might lead nowhere and delay the job unduly. On rush jobs, obviously, the patternmaker had little time for consultation with the moulder. His sympathy was with the patternmaker; but, all the same, moulders were good, hearty fellows who put up with various difficulties and made the best of them. Mr. Brown quoted a case as showing that the job could not possibly stand a thousand castings. He referred to flywheels and rope pulleys some 12 ft. in diameter and 6 ft. wide. These were made in a segment of coreboxes, with the arm of the pulleys going through the middle of the box to the outside, the rope grooves being built up in cores. The mere fact of handling the boxes would end in them being in pieces long before a thousand castings were made.

Camber

As to camber, Mr. Brown recalled the making of ornamental gates, with cast-iron segments, which were 14 ft. high and 2 ft. wide. They were made in four flat sides and bolted together, and sometimes it took three or four moulders two days sprigging the mould for the ornamentation. To decide on the camber was a question of trial and error. The men had an idea of how much camber to put on, but most of the panels had to be heated over the blacksmith's fire and placed under the steam hammer to straighten. It was very seldom one came out straight, and the question generally was a difficult one. Probably some of their troubles as moulders would be obviated if patternmakers had the opportunity to work from their own patterns in the foundry.

AUTHOR'S REPLY

MR. EDWARDS, replying to the discussion, said that if there was one thing he had studied for over 40 years it was how to assist the foundry. While he agreed to some extent with a patternmaker having some foundry experience, any patternmaker worth his salt would consider the moulders' difficulties. Incidentally, he should read THE FOUNDRY TRADE JOURNAL. In that way a patternmaker could learn a good deal about foundry problems in relation to patterns. The President spoke about a metal frame to keep patterns true. The only objection he had was that a metal frame added weight to the pattern and rendered the work of the moulder still harder. His idea was to reduce moulding work to the lightest possible degree consistent with sound results; the moulder would still have plenty of arduous work to do. He would rather adopt some plan for strengthening up a pattern by appropriate means, such as "framing," rather than add a quantity of metal. He agreed that if patterns were to be thrown off into the foundry straight away they were just as well without paint as with paint. They could then get them rubbed down and painted. Regarding the point of mould moisture raised by Mr. James, he agreed that patterns well varnished would defy moisture. He still had wooden patterns, from which 5,000 to 8,000 had been run off. Perhaps twenty coats of varnish had been applied. Patterns should be well rubbed down after use and given another good coating inside and out. A varnish which was reliable, and which they might call a good enamel, would defy most moisture conditions that the moulder could subject it to. As to Mr. James' remarks on camber, he appreciated the work of Longden on that subject. It was the most advanced of the kind, and although it did not apply to every case, it was very valuable. But if the individual moulder could manage to deal with camber correctly, good luck to him.

Camber

The method of using a board sufficient to resist the bending of plywood was, as Mr. James indicated, quite useful in regard to camber. Reverting to foundry practice for the patternmaker, Mr. Edwards said he did not hold with the latter spending six months there. He himself had obtained much knowledge by talking to good moulders. No patternmaker could learn moulding in six months. He advised patternmakers to question moulders on certain points. The way to obtain knowledge, he found, was bit by bit, and not to try to secure too much at once. They would find opportunities for going into the foundry and enlisting the goodwill of the moulder, watching the patterns being drawn from the mould and noting how the cores went into the mould.

That Pattern Colour Specification

He endorsed the method mentioned by Mr. Callaghan in preventing pipe snags; and with reference to Mr. Gardom's allusion to the British standard specification, he had spent forty years in pattern shops, and spoken to hundreds of moulders and handled thousands of patterns, and his experience led him not to

(*Concluded on page* 151)

Light Castings for Enamelling*

By H. B. McNair

In dealing with the subject of light castings for enamelling, it is not intended, in this Paper, to develop the metallurgical aspect too greatly, but to treat the problem as it applies to the practical foundryman. In so far as the latter is concerned, he is required to produce castings which will at least have the following properties:—Freedom from distortion or breakage during the enamelling process, and freedom from surface defects or inclusions likely to interfere with the application of the enamel or the properties of the finished product.

The first of these properties, *i.e.*, the ability of the material to withstand physical changes during enamelling, is partly a question of design and partly one of strength of material. It is not intended to discuss the design of castings for this purpose, as the subject merits a fuller treatment than can be attempted here, but to confine the issue to those factors under the control of the cupola and the moulding shop. When the surface of a casting, from a green-sand mould, is sandblasted previous to enamelling, a number of small holes and dark-coloured patches may be laid open, usually in the vicinity of runners and gates. These inclusions can often be scraped out, leaving rough depressions in the surface, which must be filled in with some compound before the enamel can be applied. In addition to this, the casting may fracture during the annealing or subsequent treatment, although analysis, design and other factors may appear quite normal.

In tracing the probable cause of these defects, it is found that when molten metal enters a mould, impurities from at least three distinct sources immediately begin to accumulate. Firstly, the heat and flow of the iron cause a certain amount of erosion of the mould, and the dirt so formed will naturally rise to the upper surface of the metal, accumulate and form a dirty patch on the surface. Secondly, the metal generates steam from the moisture in the facing sand, resulting in a surface oxidation accompanied by a liberation of hydrogen, the latter escaping through the vents of the mould along with the other gaseous products. If such oxidation does take place to any marked degree, the result will be a scale similar to that formed on wrought iron in a smith shop. The third source of trouble is associated with the metal itself, and may be caused by impurities in the materials charged, oxidation during melting with the formation of complex oxides, and by slag mechanically retained by the metal. These three, then, are the main sources of trouble, and no matter how careful the moulder may be, dirt will always accumulate from them more or less.

Cupola Control and Materials Used

In making a selection of raw materials for the cupola melt, reliance is usually placed upon analyses either determined in the laboratory or taken in good faith from the suppliers. In the case of pig-iron, apart from the constituents already mentioned, there are impurities present to a greater or less degree which may detrimentally affect the resultant casting. These are generally in the form of complex oxides, and can be recognised under the microscope at low magnification. The practical foundryman will agree that there are such irons, sound as regards analysis, that are mechanically weak and brittle, and are to be regarded with suspicion. This weakness is undoubtedly due to the impurities mentioned, and will be found difficult to eradicate, the usual method being to "dilute" the impurities by the addition of a pig-iron of superior quality.

The ordinary method of cupola fluxing by calcium carbonate (limestone) or calcium fluoride (flux) has little or no effect on the removal of such impurities, and a deoxidiser must be employed either in the cupola itself or in the bogies. There are a number of such deoxidisers on the market, such as ferro-manganese, carbon-free manganese, ferro-titanium, ferro-chrome, etc. Reduction by manganese or its alloys with iron is the most popular method, however, and a certain amount of success can be expected if the procedure is carried out correctly. The best results will usually be obtained by additions of carbon-free manganese in briquette form to the bogie, as the affinity of manganese for oxygen and sulphur is so great that cupola additions are apt to result in a heavy loss of the manganese before the latter can effect any deoxidation of the metal. Definite improvement can be obtained, however, by additions to the metal in the bogie, and if properly carried out, improved physical properties will result. When using manganese in this form, it is generally claimed that, as only 0.20 per cent. to 0.40 per cent. manganese is required to deoxidise the metal, any excess manganese will pass into the metal, and have a refining action upon it. These claims appear to be borne out in practice to a certain extent, the tensile and transverse strengths being increased by amounts up to about 10 per cent. When ferro-manganese or spiegeleisen is used, however, there is a danger of the manganese being totally taken up by the iron with very little scavenging or reduction of the oxides. The manganese here is in the form of a double carbide of iron and manganese, and before the manganese is free to effect any reduction this double carbide must be broken down. The breakdown takes place comparatively slowly, and only at fairly high temperatures, so that unless these factors are in its favour, most of the manganese will find its way into the metal without any reaction upon the oxides, and will probably result in a loss of fluidity and chilled castings. Briefly, then, the mechanical strength can be definitely improved by deoxidation, but preferably by free manganese addition to the bogie. The dangers of using dirty, rusty, or very light scrap in the cupola need hardly be stressed here, as this point has been laboured repeatedly in technical journals. Such practice will usually produce an iron mechanically weak, for the reasons already stated, and deoxidation by some method must be resorted to.

A further source of oxide inclusion in the metal is in the blast condition. It is indisputable that a low blast pressure, in conjunction with the proper volume of air, which is more important, will give good results, but it is often impossible—especially when fan speed, blast main size and tuyere areas are fixed—to deliver the necessary weight of air per minute to give the hottest and most efficient melting. If an increase in fan speed is possible and is attempted in an effort to increase the melting rate and metal temperature, then in all probability oxidation of the metal will occur. Again, a dense coke or one with a poor combustibility will tend to give a slower combustion, and therefore a lower melting rate, and it follows, if the combustion is slower than usual, and if the same volume of air is passing through the cupola, there must be an excess of air or oxygen over the required amount, and this will readily cause oxidation of the metal. If, therefore, fast and efficient melting conditions are desired, the combustibility of the coke should be as high as possible, and if in addition oxidation is to be avoided, the air condition, both volume and pressure, should be adjusted accordingly.

Cupola Cokes

Generally, in foundry practice, the question of ash and sulphur contents of coke is a secondary consideration, more attention being paid to calorific value and combustibility, *i.e.*, the possible melting rate attainable. But actually the ash, and therefore the sulphur content, of the coke is extremely important in view of the possible sulphur pick-up. It has been shown by experiment that practically all the sulphur originally present in the charged metal is retained in the re-melted iron, while from 30 per cent. to 50 per cent. of the sulphur in the coke is picked up by the charge. The amount of sulphur picked up appears to depend on at least three factors, namely, (1) the percentage of sulphur already present in the metal; (2) the percentage of sulphur in the coke; and (3) the temperature of the molten metal, and slag. The first two factors are closely related, so that there is no advantage in starting off with a low-sulphur charge if the coke has a high sulphur content, as the resultant melt will probably be high in sulphur. Very little of a definite nature has been done on the cupola in the examination of the sulphur pick-up with variations in ash and sulphur contents in the coke, but some work has been done on their effects on blast-furnace working, and an examination of the results might be interesting. In a published report by C. S. Gill, he gives a comparison between ash content of the coke charged and the average sulphur in the resultant pig-iron. Unfortunately, the sulphur contents of the cokes are not included, but it is assumed they were proportional to the ash contents. He took hourly analyses of coke and pig-iron over a period of 29 hours, and his results, graphed, shows the following results:—

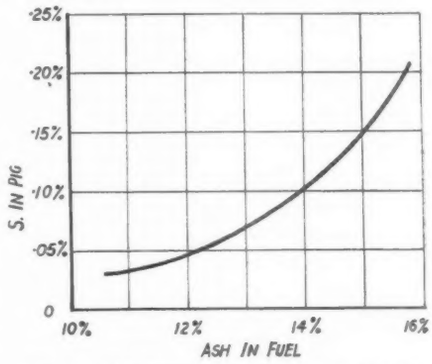

FIG. 1.—SULPHUR INCREASE IN PIG-IRON RELATED TO ASH IN COKE.

Personal observations on the cupola tend to show that the "pick-up" in the melt rises very sharply when the ash and the sulphur in the coke rise comparatively slightly. The third factor, *i.e.*, the metal temperature, has a definite bearing on the sulphur content of the melt by virtue of the increase in solubility in the iron of the metallic sulphides, with increase in temperature.

Limestone Fluxing

In turning to the question of elimination of sulphur from the melt, there are two methods open to the foundryman. The first method is limestone fluxing. The addition of limestone to the cupola charge by about 25 per cent. of the coke weight will result in a lime content in the slag of about 30 per cent., at which point the maximum amount of desulphurisation is supposed to have been reached, the slag containing about 0.8 per cent. sulphur. The addition of fluorspar (calcium fluoride) will produce a more fluid slag, but the reduction of sulphur is affected very little. It is regarded as certain,

* A Paper read before the Falkirk Section of the Scottish Branch of the Institute of British Foundrymen, Mr. T. Shanks presiding.

however, that a fluid lime slag is a better desulphurising agent than a viscous one. These two conditions will probably arise in the shallow well and in the deep-well cupolas. In the latter, where the slag is considerably below the fusion zone, its temperature falls, and it becomes viscous and loses its desulphurising properties. As mentioned previously, it is only the sulphur in the coke which is affected, the limestone addition appearing to have no effect on the sulphur in the charged metal.

The second method of desulphurisation entails the use of high-manganese pig in the charge or the use of free manganese or manganese alloys, as mentioned previously, for the reduction of oxides. In this case, however, it is best that the reactions take place in the cupola, as they depend on the well-known law that "the ratio of the FeS : MnS in the slag to the FeS : MnS in the metal is a constant." Therefore, if the sulphur in the metal tends to rise, part of it will pass into the slag to maintain the constant, *provided* the slag is reasonably rich in MnO and FeO. This is probably what occurs, especially when free Mn is added to the charge, as, allowing for the maximum of 0.40 per cent. Mn required for deoxidation, the excess of Mn added does not seem to reappear wholly in the metal,

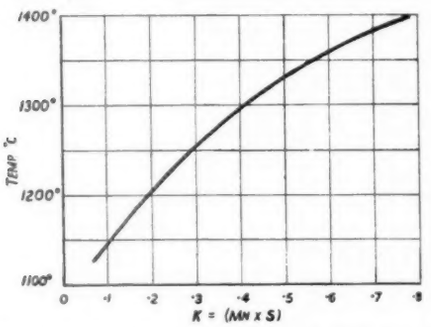

Fig. 2.—Showing Influence of Temperature on Sulphur-Manganese Content.

but is probably oxidised and enters the slag either as MnS or MnO. Over a considerable number of tests the highest percentage of Mn recovered was approximately only 10 per cent. of that added in the free state to the charge. The cost of this method is a little high, and the results are apt to vary considerably, part of the desulphurising effect being probably negatived by a further "pick-up" due to superheated metal. This will tend to occur during the first hour of the melt, when conditions are in favour of hot and fast melting, resulting in an increased solubility of sulphides in both slag and metal. The graph (Fig. 2) shows the solubility of K (Mn × S) against temperature.

The graph will explain many of the casting losses due to dirty surfaces, and holes lying just under the skin. Examination of many of these defective castings has shown the sulphur concentration at the surface to be often as high as three times the sulphur in the casting (the lower part), and in nearly every case the metal had been tapped very hot and had been drawn some considerable distance away, the drop in temperature due to the time factor allowing the sulphide to be thrown out of solution, causing segregation. In a Paper on "The Elimination of Sulphur from Iron," in The Foundry Trade Journal, June, 1929, Vol. 40, No. 760, mention is made of this decrease in solubility, with decrease in temperature, as a means of sulphur reduction, but it can only apply when the metal is in contact with slag and when the fall in temperature will not affect the fluidity of the metal. In steelmaking it is claimed that by this method, if the manganese content and the temperature are correct, 75 per cent. of the total sulphur can be removed.

Soda Ash Treatment

Of late, there has been an increasing tendency amongst ironfounders towards the use of soda-ash for desulphurisation of the melt, usually in the bogies. The reactions can be set down simply as a decomposition of the sodium carbonate into sodium-oxide and carbon dioxide. The former unites with the slag particles and iron oxide and sulphide inclusions, forming a very mobile slag of low density which rises through the metal, and acting as a cleanser, absorbs some of the sulphur present. The carbonic-acid gas, bubbling up through the metal, will assist in the liberation of occluded gases and impurities of low density, which may be mechanically trapped in the metal. It is claimed that, by the addition of from ½ per cent. to 1 per cent. of soda-ash, up to 50 per cent. of the sulphur present can be removed from the metal. It is essential, however, that clean bogies be used, *i.e.*, bogies free from cupola slag, as the presence of silicates will result in a resulphurisation of the metal. For this reason, soda-ash cannot be used as a cupola addition. In practice, the time required for the operation is a definite handicap, and the removal of the last traces of the "soda" slag is difficult. The results to be expected are limited to a partial and variable desulphurisation, no appreciable improvement in mechanical properties having been personally noted, although there definitely is a reduction in the pitting or marking of the surface of castings where these are due to sulphur.

In passing from desulphurisation, it might be advisable to mention the general attitude of several authorities on this question. They maintain that, "if the manganese be kept at a suitable figure, there does not appear in the ordinary way to be any necessity for desulphurising, particularly if cupola conditions are good and adequate limestone additions are made to the charge." The latter statement, *i.e.*, "if cupola conditions are good," requires a little explanation, for if hot metal, and therefore hot slag, are being obtained, the solubility of both these for sulphur will tend towards a maximum. The manganese content, which is stated to balance the sulphur, is calculated at 1.7, multiplied by the sulphur content, plus 0.3 per cent. manganese. In this ratio the sulphur is said to exist as manganese sulphide, and the iron is at its softest with respect to these two elements. While this rule will generally hold good, it is liable to be upset by other factors. An instance which might be mentioned, and with which most foundrymen are probably familiar, is the formation on the surface of castings of what is known as "shagreen." This takes the form of small pellet-like extrusions, usually in clusters on a flat surface, which are extremely difficult to remove by fettling. On careful removal and examination, these pellets may be found to contain about 30 per cent. sulphur and the balance iron, approximating to the iron-iron-sulphide eutectic, which contains 85 per cent. iron sulphide and 15 per cent. iron and which has the very low melting point of 980 deg. C. If sulphur prints are taken of the casting in the immediate neighbourhood of these extrusions, sulphur segregation will be found to have taken place. The castings will be hard, and will in general be mechanically weak. Yet in nearly every case which has been noticed the manganese was in excess of that required for stabilisation of the sulphur. In one case the sulphur was 0.07 per cent. (average) and the manganese 0.82 per cent., a ratio in which the sulphur should have existed as manganese sulphide, and as this has a very high melting point (1,610 deg. C.), no extrusion should have occurred, but the segregation and throwing out of iron sulphide seemed to contradict this general rule. The remaining constituents were more or less in accordance with the usual practice.

Moulding Sands and Facings

Assuming that a good sound iron, relatively free from impurities, is available, there remains the equally important question of the suitability of the moulding materials, or, what is still more important, the facing material of the mould. The chief properties required of a green-sand mould come under three headings: Permeability, Strength and Refractoriness. The refractoriness of a sand, *i.e.*, its ability to resist the conditions of reduction and fusion which exists in the mould when cast, is controlled by the amount and nature of certain constituents of the sand, such as clay (hydrated aluminium silicate), felspar (alkali aluminium silicate) and other minerals. These may be very fusible and may tend to lower the refractoriness of the sand, causing "burning on." This property of the sand, however, is rarely of vital importance in grey-iron practice, as trouble from this source is infrequent, so that the main points to be considered are permeability and strength.

Permeability is defined as the property of a material for allowing the passage of gases through it, and if the conditions which exist within the mould when cast are borne in mind, the desirability for a fairly high degree of permeability will be understood. With probably

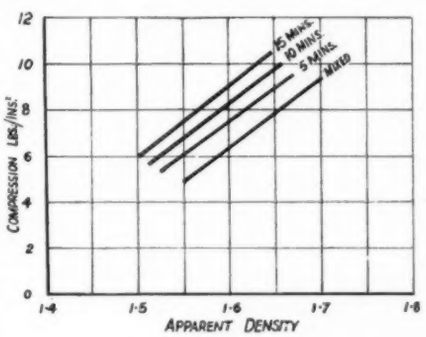

Fig. 3.—Influence of Milling on the Properties of Sand.

5 per cent. to 10 per cent. moisture and up to 20 per cent. coal dust in the sand, there will be a fairly rapid generation of steam and gas when the liquid metal fills the mould. One volume of water at ordinary temperature becomes about 2,800 volumes of steam at 1,200 deg. C., and this, if escape is not easy and rapid, will, in conjunction with the gases from the binders, cause a back pressure in the mould resulting in faulty surfaces and blowholes. The strength of the sand is its property for retaining its shape and resisting a break down when the pressure and flow of the molten metal act upon it, and this property and the permeability are governed by more or less the same factors. These are:—The size and shape of the particles; the amount and distribution of the bonding material present; the moisture content; and the apparent density of the mould, *i.e.*, the amount of ramming to which the sand has to be subjected. The mechanical analysis of a typical sand shows that it contains two main constituents. The first of these, forming 80 per cent. and more of the total weight, is composed of sharp sand, *i.e.*, grains of silica or quartz, which have no strength in themselves and depend on the second constituent for bond.

This second constituent can be termed clay, and exists normally as a hydrated aluminium silicate. Varying amounts of other materials are also present, and of these might be mentioned hydrated iron oxide, which may be present in amounts up to 4 per cent. Far from being regarded as a harmful constituent, it is found that sands which contain proportions of this oxide will usually have a longer life than those without it. This is due to the ability of the oxide to absorb water and reform the hydrated oxide, thereby maintaining the bond or strength

of the sand. The clay bond has not this property of reverting to the hydrated state on the addition of water, so that if the strength of the sand depends principally upon it, there will be a gradual weakening of the material, and it will be found necessary to strengthen it by the addition of new sand. Since the strength of the sand depends on the clay bond, it will therefore vary as the proportion of the clay varies, and as the clay is stronger in the hydrated state, it follows that indirectly the strength of a sand will vary according to the amount of moisture present.

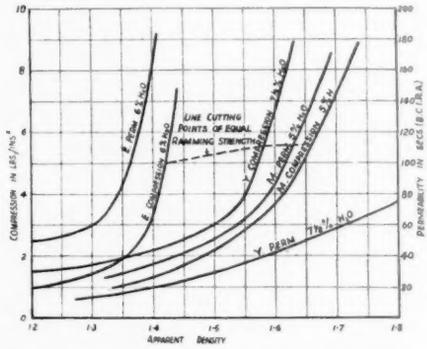

FIG. 4.—INTERRELATIONSHIP OF COMPRESSION STRENGTH, PERMEABILITY AND APPARENT DENSITY.

This statement is generally correct up to a certain moisture content and will be mentioned later.

These statements assume that other factors do not adversely affect the material, *e.g.*, the size of the quartz grains which, theoretically, should be uniform, and the distribution of the clay bond around the particles. It has been shown (in a Paper on "Sand Testing" by W. Y. Buchanan—Proceedings of the I.B.F., 1931-32) that there is a marked increase in the strength and permeability of a sand when it is properly milled.

Fig. 3 shows the strength of the sand in lbs./sq. in. against apparent density, and it can be seen that after 10 minutes' milling an increase of about 50 per cent. in the strength was obtained. The permeability of the sand was also increased by about 30 per cent. after the 10 minutes' milling. Assuming, then, that the sand is well milled, its strength appears to depend on the apparent density of the mould and the moisture content, and it will be found that upon these factors also depends the permeability. For a comparison of the strengths and permeabilities of sand with varying densities and moisture contents, several instruments or apparatus have been devised, but as yet no common ground of agreement has been reached. A year or two ago the British Cast Iron Research Association gave details of a sand-testing equipment (modified since then), which, though severely criticised, makes definite advancement towards the problem of sand control in the foundry. The equipment referred to consists, among other things, of a compression tester for the determination of the strength of a sand under direct crushing load, and a permeability instrument for determining this property. More especially in the case of the compression apparatus are objections raised, mainly to the size of the test-piece (which is 2½ in. by 1 sq. in.) and to the irregularity of the ramming obtained by hand. Modifications have been tried and better results are claimed by lengthening the corebox and using a definite weight of sand for each density required, the core being formed by compression to the usual size by means of the steady downward pressure of a rod of equal diameter to the core, the pressure being applied mechanically. The permeability test consists in ramming a cylinder of 800-c.c. capacity, determining the apparent density by weighing, and passing coal gas at a regulated pressure upwards through the cylinder, and noting the time required for the ignition of the gas at the upper end of the cylinder. To obtain some idea of the conditions under which maximum strength and permeability are obtained, a series of test-pieces are rammed to various densities but at a constant moisture content. The results are obtained and plotted graphically. The moisture content of the sand is then altered and the operations repeated, until a series of curves are obtained correlating apparent density, moisture content, strength and permeability. Generally, the results of such tests show that up to a certain point the harder a sand is rammed the stronger it will become, but after this point the strength will be reduced due to the destruction of the clay bond round the grains.

The permeability will generally drop as the apparent density rises, for the same reason as before, *i.e.*, a filling-up of the inter-grain spaces by the clay bond. It will be found difficult to directly compare the results of tests of different sands because of the difference in apparent density when rammed under the same applied load or pressure. One sand, when its strength is plotted against apparent density, may appear to give better results than another, when actually they may not be quite so good. The graphs (Fig. 4) may illustrate this point.

From the curves in Fig. 4 it would appear that sand "E" is superior as regards strength to either "Y" or "M." It was found by trial, however, that for similar ramming strengths, the apparent densities of "E," "Y" and "M" were respectively 1.42, 1.58 and 1.66. These are approximate figures, being the mean of several test-pieces rammed by hand with as near as possible the same strength. If the strengths are now compared against equal ramming strengths, "E" is seen to fall slightly below both "Y" and "M," and a glance at the permeability curves further strengthens the opinion that if a comparison of sands is to be attempted, it would be more practical to plot ramming strengths against compression and permeability. In the permeability curves the balance at first appears to be heavily against sand "E," but if ramming strengths are again considered the difference is reduced to a marked degree. It will be noticed that the graphs are plotted with sands containing a definite moisture percentage. It was stated in a Paper on "Sands and Sand-testing" by Dr. Skerl, in the Institute of British Foundrymen Proceedings for 1930-31, that "the sand has little or no strength with only small amounts of water, but

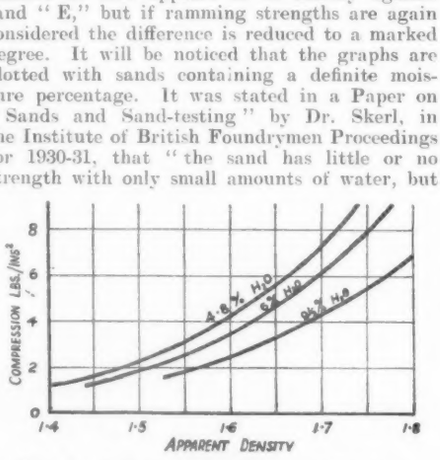

FIG. 5.—INFLUENCE OF MOISTURE CONTENT ON APPARENT DENSITY AND COMPRESSION STRENGTH.

by increasing the moisture content the strength is increased until a percentage is reached at which the sand is strongest. Further addition of water results in a decrease in the strength of the sand." In a later Paper by W. Y. Buchanan it was stated that the latter part of the statement was hardly correct. He showed from a series of curves obtained with different moisture contents, that on calculating the densities to a standard moisture content (he mentioned 5 per cent. moisture) the differences in strength disappear and the curves almost coincide. Results show this to be fairly correct, there being a rapid increase in strength up to a certain moisture content above which there appears to be little increase or decrease in strength until a H_2O content is reached which destroys the plasticity of the sand. The moisture content at which this maximum strength is obtained will, as stated before, vary with the amount of bonding material present. In Fig. 5 the curves show the compression strength of "M" sand for various moisture contents, and illustrate the above explanation of the apparent drop in strength with increased moisture above that required for maximum strength.

The results of the permeability tests cannot be explained in the above manner, the permeability of almost every sand increasing with an increase in moisture content considerably above the optimum required for maximum strength,

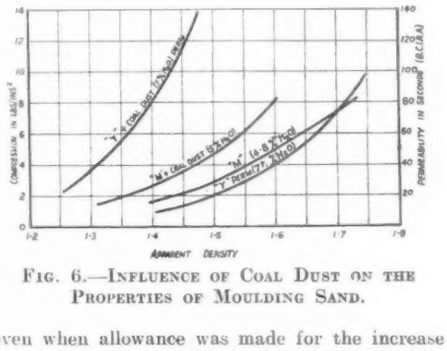

FIG. 6.—INFLUENCE OF COAL DUST ON THE PROPERTIES OF MOULDING SAND.

even when allowance was made for the increase in apparent density due to the additional moisture. From the compression curves, however, the maximum strength is seen to be obtained with a moisture content of about 4.8 per cent., and higher moistures appear to lower the strength, but if the densities are calculated back to a 4.8 per cent. basis it will be found that the curves almost coincide. The examination of several types of sand shows results all tending to support the belief that there is an optimum moisture content at which the sand is strongest, and that increase in moisture above this and up to a certain point, has little effect on the strength of the sand.

Coal Dust

As it is customary to make additions of coal dust, rock sand or other "binders" to the facing sand, an examination of their effects on strength and permeability should be considered, especially in view of the diversity of opinion regarding their functions. By increasing additions of rock sand up to 10 per cent. a slight increase in strength was shown with little or no difference in the permeability. Additions of coal dust, however, in amounts up to 10 per cent., gave results which might again give rise to confusion, there appearing to be a steady increase in strength as the coal-dust additions were increased.

Fig. 6 shows curves of "M" sand with and without coal dust at the moisture contents at which they were strongest. If allowance is made as before for the difference in apparent density due to the big difference in weight between equal volumes of coal dust and sand, then the curves come remarkably close together. Results on other sands showed very much the same results, suggesting that up to at least 10 per cent. there is no advantage gained in strength by the addition of coal dust. The results are only in accordance with what should be expected, as coal dust has no bond or strength in itself, and should, therefore, if anything, tend to decrease the strength of the sand. On the other hand, the permeability was in most cases reduced by the addition of coal dust, the decrease being greatest in the case of the sand which showed the highest permeability without additions. It would appear, therefore, that the addition of coal dust will have no beneficial effect on the facing sand either as regards strength or permeability, *i.e.*, up to the percentage already mentioned. If any benefits are to be derived from its addition, then they must extend in some other direction.

Several authorities maintain that the true function of coal dust is to give the surface of

the casting a better colour and finish, said to be caused by the film or tarry vapour volatilised from the coal on heating. A Paper by J. Pillon in the Proceedings of the I.B.F., 1931-32, further states that the percentage of coal dust added should vary according to the thickness of the metal to be cast. Again, it has been frequently stated in technical Papers that the advantage from the use of this material lies in the increased permeability obtained, due to the formation of coke particles from the coal dust. These statements appear to contradict each other, for if a gaseous layer between the metal and the mould is aimed at, then permeability can be of little account. Further, the formation of coke particles from the coal dust obviously means an increased volume of material, which can only take place at the expense of the permeability of the sand, which would appear to be much more important than that of the very fine pores of the small particles of coke, and, even allowing that any advantage is gained in permeability, this must be counteracted by the increased volume of gas. As for the statement that the fine blue finish on a casting is due to the use of coal dust, the same effect can be readily obtained from the use of a well-milled and graded sand containing a fair proportion of the hydrated ferric-oxide bond previously mentioned, and with no coal-dust addition. In so far, however, as a fine surface finish and colour for enamelling work is concerned, there would seem to be no reason for aiming at this, then proceeding to destroy it by sandblasting. Like coal dust, blacking and plumbago have no strength in themselves, and if applied to the mould, will at least result in a decreased permeability. Personal experience has shown that in no case has either blacking or plumbago been beneficial to the surface of a casting for enamelling, unless the facing sand has been extremely poor, and that usually the flow of metal causes the material to be "washed" into pockets or seams, resulting in a disfigured surface when the casting is sandblasted.

Gating and Pouring

The question of gating and pouring of the mould, like that of design, is one in which each type of casting requires individual consideration. Whenever possible, however, gates should always be on the edge and not on the face of the casting, and should extend along its length as far as is practical. An economy in gates will only result in an additional burden being thrown upon the facing sand which is directly opposed to the flow of metal, with a consequent "tearing up" of the former. The inference, therefore, is to fill the mould as easily and as quickly as possible. The pouring temperature will then depend, to a great extent, on the method of pouring and gating. The rusting of castings, which occurs when they are allowed to lie in contact with moist sand, is a frequent source of annoyance to the enameller, as it is maintained that, even after sand blasting, the rust will persist and cause trouble during the enamelling process. An examination of several such castings revealed that the depth to which the rust had penetrated was comparatively slight, and the removal of the rust by an abrasive or by filing before sand blasting gave surfaces which enamelled perfectly. This would suggest that "blasting" the surface, either with sand or steel grit, is by no means the best method of removal of the rust, and it might be advantageous, in such cases, to thoroughly clean the surface before sand blasting by means of an abrasive.

Conclusion

In summing up, personal experience has shown that there are two chief sources of trouble. Firstly, there is metal rendered unsound either by mechanically-retained inclusions or by "unbalanced" sulphur. Such iron can be considerably improved by deoxidation or desulphurisation. The second source of trouble is the moulder's sand heap, and without detracting in any way from the ability and carefulness of the average moulder, it may be stated that by far the greater portion of the trouble which develops, especially in relation to dirty and deformed surfaces, orginates in the sand. If more attention is paid to the maintenance of a suitable sand, strong and permeable, the percentage of enamelling-shop rejects will drop accordingly, and the foundryman will find himself able to turn his attention, in greater detail, to this problem.

Patternmaking

(*Concluded from page* 147)

agree with it. He said this from his own knowledge of patternmaking, from his acquaintance with foundry work and with general engineering practice, and he considered it useless. He believed the idea was first suggested by America, and was then approved by the British Committee. In the long list of sponsors, headed by the Admiralty and the mechanical engineers, the poor patternmakers were placed at the bottom. He regarded it as a presumption that those who knew nothing about patternmaking should put forward a pamphlet and want 2s. 2d. for it in order to tell them how and what to varnish and so on. It was the patternmaker who should decide what to do with the paint. The whole thing was an effort to tie the patternmaker down to a standardised principle which was wrong, and if adhered to would cause trouble. What about patterns which have to be made under stress, or patterns which have to be produced at the cheapest price? Surely they could point where the metal was, or the core print, or what should be stopped off as occasion demanded, without a rigid standardisation which was uncalled for. He must confess that he had met with several curious methods or systems devised by people who did not know much about the subject, but he was fortunate in respect to his present firm. Mr. Gardom suggested that the stamping of the contraction of the metal employed in the pattern as recommended by the pamphlet would be helpful. In some cases this would be unworkable; as, for instance, in the cast iron and aluminium combination which he had spoken of. The patternmaker should use his own judgment, and he considered the works' management would be wise in leaving the patternmakers to work out their own difficulties, without imposing systems arranged by people who did not realise whether they were practicable. As to Mr. Greenway's idea of core boxes being screwed together, if it was a standard job this plan could be usefully followed. In the case of the core box with tapered shell, this formed a collapsible core box without thumb screws. Finally Mr. Edwards said he agreed with consultations between the patternmaker and moulder, but the moulder did not generally understand drawings. The foundryman preferred a clear cut question and not a series of theoretical inquiries. Some of the patterns he had shown had stood up to 1,000 castings, and were made twelve to fifteen years ago, but admittedly they were light in character.

[Mr. E. J. Lewis was chairman of the meeting at which this Paper was read, and not, as reported last week, Mr. E. Thomas.]

Messrs. C. A. Parsons & Company, Limited, of Heaton Works, Newcastle-upon-Tyne, have received from Imperial Chemical Industries, Limited, for the Castner Kellner Alkali Company, Limited, Runcorn, an order for a 15,000-kw. turbo-alternator and exciter, complete with surface-condensing plant. The machine will be of the two-cylinder tandem type, with a normal running speed of 3,000 r.p.m., and will be designed for operating with steam at a pressure of 600 lbs. per sq. in. gauge, at a temperature of 800 deg. Fah. The alternator will generate current at 10,500 volts, 50 periods.

Random Shots

"Marksman" has heard in strict confidence, from an entirely unreliable source, that the movement towards more and brighter Commodity Development Associations is well under way, and that sensational events may be expected in the near future. Sheffield is all agog over plans to assist the cutlery trade, and the cry of "use more spoons" is being variously interpreted to mean that supping soup with a knife really must stop and that spooning is to be encouraged. With spring in the air, it seems not unlikely that among the younger generation little encouragement will be needed!

* * *

Then steel. There was some trouble, "Marksman" believes, at the preliminary meeting over a misconception on the part of a deaf delegate from a local charitable organisation, who had strayed into the proceedings by the old and tried method of taking the wrong turning. He, it was, who rose in indignant protest against a resolution to promote more stealing, but the casting vote being with the chairman, who is understood to have been a man of iron, the interruptor was duly cast—in a vertical position.

* * *

Pig-iron consumption has shown a welcome increase of late, but the ironmasters are said to be not entirely satisfied to rest on their laurels (horticulturists maintain the position is lacking both in dignity and comfort), while a small section says bluntly that the use of the prefix "pig" must inevitably lead to trouble with the newly constituted Marketing Board. Contemptuously dismissed by the majority as an incipient attack of swine fever, this objection may yet lead to a division in the ranks, but it is hoped that wiser councils will prevail and that members will not cut up rusty. Great satisfaction is felt over the movement to encourage the public to have as many irons in the fire as possible, and co-operation with the colliery owners is confidently predicted, while, but for the fact that the Home Office is looking askance at the growth of semi-militaristic organisations, the resuscitation of the Ironsides might well be attempted.

* * *

The notable efficiency of this country's admirable police force is, so "Marksman" understands, proving of very great assistance to the propaganda work of the Copper Development Association, while there is talk of the Buffer Tin Pool being thrown open for mixed bathing this summer should the scheme be defeated by the efforts of the Metal Exchange and other opponents of liquid resources. The spelter producers—although to judge from their programme of production they believe in half measures—are understood to be fully alive to the need for encouraging the consumption of their product, and have made up their minds that they will zinc or swim together. It is a fine sentiment, and their laudable intention is expected to lead to considerable activity in the life-belt industry, which has not been too well occupied since the drought set in.

* * *

The makers of small tools are on edge with expectation anent the formation of an association to encourage the wider use of the many and various articles they manufacture. To this end it is said that a small but influential body is getting in touch with young and ambitious politicians, bent on carving out their own careers, and an endeavour such as this undoubtedly augurs well for the future of this industry. Boring his readers, however, is certainly not "Marksman's" wish, and he therefore begs leave to write Finis to this week's News. One word in conclusion: He has been approached by the shotmakers. Isn't that splendid?

Marksman.

XUM

National Federation of Iron and Steel Manufacturers

NATIONAL SCHEME OF REORGANISATION ADOPTED IN PRINCIPLE

At a special general meeting, following the annual general meeting of the National Federation of Iron and Steel Manufacturers, held in London last Thursday, upwards of 200 representatives being in attendance, the following resolution, moved by Mr. E. J. George, and seconded by Sir John Beale, K.B.E., was passed by 76 votes to 28 against.

"That this Special General Meeting of the members of the National Federation of Iron and Steel Manufacturers accepts in principle the revision of the constitution in the general terms of the printed draft circulated to the members on January 4, 1934, and directs that a committee be appointed from this meeting to prepare a final draft constitution in general accordance therewith, but giving effect to amendments suggested by counsel and taking into consideration suggestions or amendments which have already been received or may arise as the result of subsequent discussion at this meeting or which may be received from any member by the Secretary of the Federation in writing on or before March 8 next. This meeting further directs that such final draft be submitted for acceptance to a special general meeting of the Federation to be convened on April 19, and that a print of such final draft be sent to each member together with or before the notice convening such meeting."

The committee appointed in the terms of the resolution are:—Sir Frederick Mills, Bt., M.P., Mr. C. U. Peat, M.P., Sir William J. Larke, K.B.E.

Note.—It should be explained that the difference between the number of votes and those present is due to the fact that only one vote is permissible for each member firm.

ANNUAL DINNER

The annual dinner of the Federation was held at Grosvenor House, Park Lane, Mr. James Henderson, J.P. (President), in the chair. In addition to the principal guests, the Rt. Hon. Walter Runciman, M.P. (President of the Board of Trade), and the Hon. Oliver F. G. Stanley, M.C., M.P. (Minister of Transport), those present included Sir George May, Bt., K.B.E., Sir John Beale, K.B.E., Col. Sir W. Charles Wright, Bt., K.B.E., Sir Harry Peat, K.B.E., Sir Frederick Mills, Bt., M.P., Sir Wm. Gowers, K.C.M.G., Sir Wm. J. Firth, Mr. Charles Mitchell, Mr. E. J. George, Hon. R. D. Kitson, D.S.O., M.C., Mr. A. J. Grant, Mr. J. Craig, C.B.E., Mr. W. Benton Jones, Lt.-Col. J. Colville, M.P., and others prominent in the foundry industry were Mr. P. B. Brown, Mr. H. E. Cookson, Mr. V. Delport, Mr. W. E. Dobson, Mr. E. C. Evans, Mr. V. C. Faulkner, Mr. A. A. Fellows, Mr. E. J. Fox, Sir Harold Hartley, F.R.S., Dr. W. H. Hatfield, Capt. R. S. Hilton, Mr. J. E. Hurst, Mr. W. T. Kitching, Sir W. J. Larke, Mr. S. C. E. Lloyd, Mr. H. W. Lockwood, Mr. W. R. Long, Mr. G. T. Lunt, Dr. A. McCance, Mr. A. C. Macdiarmid, Mr. A. N. McQuistan, Capt. J. Miles, Mr. K. H. Morley, Mr. R. H. Myers, Mr. W. R. Osborne, Mr. J. G. Pearce, Mr. W. B. Pickering, Mr. T. M. Service, Mr. James Smith (President of the National Ironfounding Employers' Federation), Mr. A. W. Steven, Mr. B. Walmsley, Mr. G. E. Wells, and Mr. C. E. Williams (President of the Institute of British Foundrymen).

"The Iron and Steel Industry"

The RIGHT HON. WALTER RUNCIMAN, proposing the Toast of "The Iron and Steel Industry," said that during the past few years anybody with a pair of observant eyes could see for himself as he moved about the country that the departure from the old traditional fiscal policy of this country, forced on it by changed circumstances, had proved of benefit to the iron and steel industry. He did not feel it necessary to excuse the Government for this policy, but, at the same time, he took the opportunity of pointing out how wildly inaccurate had been the prophecies of some of those who opposed the Government policy. Tariffs had been an unmixed blessing up to date, not only for those who catered for the home market but for those who wished to obtain, and were obtaining more and more foreign orders. Nobody imagined for a moment that the export trade had recovered its old prosperity or that we were likely to jump into the first place in a very short period of time. Nevertheless, if the effect of tariffs on the export trade was measured on a tonnage basis there had been a most remarkable increase during the past twelve months. In the first quarter of 1933, the total tonnage of exports of iron and steel was about 430,000 tons. In the last quarter of 1933 that had grown to 580,000 tons. It was quite true that the increase had not been all along the line, but, at all events, it proved the doctrine that under proper, scientific, cautious and moderate management we could make import duties an untold benefit, not only in the country but in our export trade. Everybody knew that if we could only keep our plants working somewhere within 80 per cent. of their capacity we must of necessity be doing very much better and on a very much lower scale of prices than on the basis of 50 per cent. capacity. That simple fact, however, did not sink very deeply into the mind of the doctrinaire, and he (the speaker) could not help feeling that to some extent the industry itself was to blame for the facts of the iron and steel industry not being sufficiently well known in this country. It was important to remember that the import duties now enjoyed by the industry were dependent upon public opinion, and the industry should be very careful to see that that public opinion was so nourished that it would be possible for a Government in the future to continue the benefits now enjoyed by the industry. There were some people who would like the Government to give unlimited pledges as to the future, but nobody who had ever been in Government would be so foolish as to go ahead of public opinion.

Continuing, Mr. Runciman said that another test applied by doctrinaires to the Government's policy was what effect it was having upon employment, but that question was never asked now. The progress of the past twelve months had destroyed that argument, for the very remarkable increase in the numbers of those fully employed in industry was evidence itself that there had been a change for the better, and fully justified the Government's policy. There was also the direct test of the effect of the duties on the trade, and it was only necessary to look at the statistics of imports to see what a change there had been for the better.

He understood that earlier in the day something had been said of the proposals which had been made by the Government on a conditional basis for the reorganisation of the industry, and he could only express the hope that the industry would press on with the work which they had begun that day and that a proper measure of reorganisation would be brought about. The Government would far rather it was brought about on a voluntary basis than be a subject for Departmental or Parliamentary control. Associated with that was the inquiry which had come from some quarters as to what the Government was going to do for the future. In that connection he must say quite frankly that the Government must necessarily reserve complete discretion. It would be ready to give the industry such support to its effort as might prove necessary to complete its reorganisation so long as the Government was satisfied of the determination of the industry to set its house in order. There was one aspect of reorganisation to which special reference should be made and that was that he hoped nobody would imagine that a mere price-fixing arrangement was sufficient to fulfil the requirements of reorganisation. It was part of his duty to look after the interests of the consumer. Incidentally, he suggested it was even more to the interests of the industry that it should do so, because any exploitation of the consumer would not only be bad for the consumer but bad for the industry as a whole.

Reply by the President

MR. JAMES HENDERSON (President of the National Federation of Iron and Steel Manufacturers), replying to the toast, extended to Mr. Runciman, on behalf of the industry, their high appreciation of his sympathetic and active interest in its progress and wellbeing. The position of the President of the Board of Trade must have been peculiarly difficult and trying during the period of the present Government, covering as it did a complete departure from the fiscal system of generations. The application of commercial treaties which were based on a free trade system to one of protection could have been no sinecure.

Proceeding, the speaker said that the industry accepted the responsibilities involved in self-government, and at their meeting that morning they had taken a very important step in discharging these duties. They gratefully acknowledged that the Import Duties Advisory Committee and the Government had progressively endeavoured to facilitate the industry's task, and they were greatly heartened in their efforts by the belief that Government policy would continue to be directed to supporting and strengthening them.

The year 1933 which had recently closed was the first full year in which they had enjoyed the existing tariffs plus the important auxiliary of the depreciation of sterling. Steel ingot production in 1933 showed an increase of one and three-quarter million tons over 1932 with a reduction of 620,000 tons in imports of steel of various classes, so that fully one million tons increase was due to general improvement in demand in this country. The total exports were definitely higher than they were a year ago, although the latest returns showed some fall from the high figure of last October. On the other hand, there was a substantial increase in the volume of imports of iron and steel in January, and that would be closely watched in succeeding months. He would not try to draw any disturbing deductions which might prove to be premature. But they could draw encouragement from the fact that the productions of pig-iron and ingots in the month of January were the highest recorded for some years. In that connection he was sure he need not remind the President of the Board of Trade of the serious effect that the departure from the gold standard of any of our chief competitors would have both at home and also in the neutral markets of the world. The latter aspect would present a difficult problem; he hoped that they safely assumed that the Government were prepared to deal adequately with the problem for the home market should it unfortunately arise.

Continuing, the speaker said that with regard to their plans for the future, he had faith in their ability to manage their own affairs, and he believed that this faith would be justified by their works. It might, however, be of some service if he offered a few general observations on the scope of the scheme of reorganisation which was now before the steel industry. They had been criticised for attempting to create a scheme so drastic and bureaucratic in character as to be a menace to themselves and their customers. On the other hand, they had been told that it was so anæmic as to be only tinkering with a great problem, and that it would be quite ineffective for its purpose.

He believed that the truth lay between these extremes, and that events might yet prove that they had shown a prevision and wisdom which they might have doubted their ability to attain when they started on this important undertaking. The truth was, as he thought all reasonable people would recognise, that those in the iron and steel industry were more concerned than any of their critics in restoring employment to their people. After all, they who controlled the industry were more intimately and directly concerned with its welfare than anyone else, and they ought to be in a better position to devise ways and means for securing that result. The problems of production had to a large extent been solved. Their technological progress in the last few years had been remarkable, in spite of the financial difficulties under which they had laboured. He believed that their progress in recent years had been at least equal to if not greater than that in any other country.

Their difficulties had been aggravated largely by unrestricted competition in an ever-decreasing world market, with the result that their companies had been making losses, or at least inadequate profits, and dissipating their capital resources. It was because they must first direct their attention to reconstructing the economic basis of their industry, both nationally, imperially and internationally, that their efforts had been so largely directed to replacing competition by co-operation in the commercial sphere. He gladly bore testimony to the degree of co-operation that had already been established between the steel industry and the consumers of its products, a policy that was being actively

(*Concluded on page* 154)

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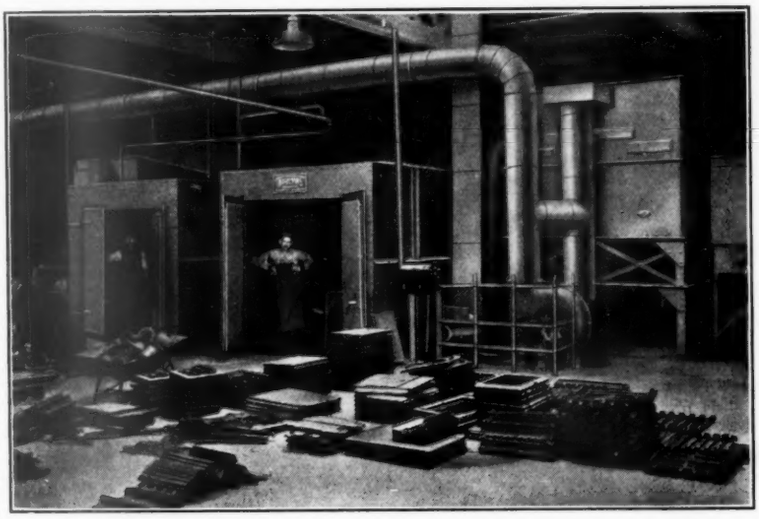

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This Week's News in Brief

Trade Talk

ANOTHER INCREASE in the price of Scottish pig-iron, for which there is an exceptional demand, is anticipated.

THE INTERESTS of the Briton Ferry Steel Company, Limited, in the Llanelly Steel Company (1907), Limited, have been sold to the shareholders of the latter concern.

THERE HAS BEEN UNLOADED at Bowling Harbour this week the largest cargo ever discharged at the port. It consisted of a consignment of 1,045 tons of Cumberland pig-iron.

THE ANNUAL SOCIAL MEETING of the staff and employees of the Muirhall Foundry, Larbert, was held on February 16. Mr. George Ure presided over the proceedings, which included tea and a concert programme, followed by a dance.

SIR WILLIAM ARROL & COMPANY, LIMITED, Glasgow, are to instal the heavy machinery in the new factory which is being built for the Scottish Dyes at Grangemouth. Sir William Arrol are also contractors for the steelwork construction of the £45,000 factory.

THE GERMAN PRODUCTION of iron and steel marked a big increase in 1933. The output of pig-iron was 5,266,769 tons, compared with 3,932,511 tons in 1932, and the output of steel 7,585,722 tons against 5,746,856 tons, the advance in both cases being thus one of about one-third.

THE ANNUAL DINNER of the Scottish Iron and Steel Scrap Association was held in the North British Station Hotel, Glasgow, on February 22. A diversified musical programme was provided, and a novel feature in the form of a cinematograph film which was "shot" at the annual golf outing of the Association during the summer.

IT IS OFFICIALLY ANNOUNCED from Buenos Aires that Imperial Chemical Industries, Limited, are merging their interests in the Argentine with those of Du Pont de Nemours & Company, the American steel and armaments firm. A new company will be formed for the purpose with a capital of 15,000,000 pesos (£1,000,000 at present rates).

MESSRS. STERLING FOUNDRY SPECIALITIES, LIMITED, Sterling Works, Bedford, have appointed Messrs. Parson & Colls, Limited, of Clarendon House, Clayton Street West, Newcastle-upon-Tyne, to be their agents for Sterling rolled steel moulding boxes on the North-East Coast. Their territory covers the whole of Northumberland and Durham and includes the town of Middlesbrough.

THE L.M.S. PADDLE STEAMER "Mercury," which is of a new design for the Clyde pleasure fleet, having a raked bow and cruiser stern, and being fitted with two masts, and built by the Fairfield Shipbuilding & Engineering Company, Limited, has successfully carried out trials on the Firth. The new steamer, "Princess Margaret," which was built by Messrs. Denny Bros. & Company, Limited, Dumbarton, for their own ferry service on the Firth of Forth, has also run successful trials.

THE MEETING OF THE London Branch of the Institute of British Foundrymen, arranged for March 7, has been postponed because it is on this date that the Institute of Metals is holding its annual dinner, and several foundrymen will probably wish to attend that function. The next meeting of the Branch has therefore been arranged for Wednesday, March 14, at 8 p.m., at the Charing Cross Hotel, London, W.C.2, when Dr. A. B. Everest will give a Paper on "Potentialities of Cast Iron."

AN INTERESTING and informative booklet dealing with new products and processes in the city and surrounding districts has just been issued by the Development Board for Glasgow and district. Some of the products and processes are local inventions, and some are being carried out under a royalty system or other arrangement with foreign owners of patents. The articles which have been published each month in the Chamber of Commerce Journal are suitably illustrated, and show the wide developments that are taking place in Clydeside industries.

THE PRODUCTS of Falkirk foundries are well represented at the British Industries Fair, comprising exhibits of ranges, stoves, grates, mantles, portable boilers and agricultural apparatus by Allied Ironfounders, Limited; Carron Company; M. Cockburn & Company, Limited; Falkirk Iron Company, Limited; Forth & Clyde & Sunnyside Iron Company, Limited; M'Dowall, Steven & Company, Limited; Mitchell Russell & Company, Limited; Smith & Wellstood & Company, Limited; and the Grangemouth Iron Company, Limited.

THE AMBULANCE CLASS of Messrs. John G. Stein & Company, Limited, held their annual social meeting in the works canteen at Castlecary on February 23. Mr. Charles Taylor presided over a very large company of members and friends. Mrs. Pearson, after tea, presented the prizes won during the session. Addresses were given by Dr. Pearson, lecturer to the class, and by Dr. John Young, of Bonnybridge, and Mr. Kelso Park and the chairman. Thereafter a musical programme was provided by a company from Bonnybridge, followed by a dance.

ANOTHER CARGO for Russia has been loaded at Glasgow. The Soviet steamer "Kalinin" at Princes Dock took on about 3,000 tons of steel plates, tubes and similar West of Scotland products for Odessa. The shipments now being made are part of the large contracts which were placed in the area and shared by several firms. Cargoes have been despatched at intervals over a considerable period, and now it is learned the contracts are at the concluding stage. There are no new contracts in view at present, but under the new trade agreement there is a possibility of further orders for Russia being encouraged, and it is hoped that if there is a renewed demand by Russia for steel products, the West of Scotland will receive a good share of the work.

Company Reports

Crossley Bros., Limited.—Profit, £3,232; brought in, £13,284; carried forward, £16,516.

Enfield Cable Works, Limited.—Final dividend on the ordinary shares of 10 per cent., making 20 per cent. for 1933.

Hammond Lane Foundry Company, Limited.—Net profit for 1933, £8,460; brought in, £1,454; dividend of 10 per cent., plus a bonus of 8d.; to reserve, £4,452; carried forward, £462.

Charles Clifford & Son, Limited.—Net profit, £8,079; brought in, £30,869; final dividend of 1s. 6d. per share on the ordinary shares, making 10 per cent. for the year, free of tax; carried forward, £31,149.

Mather & Platt, Limited.—Net profit, including re-transfer of reserve for contingencies, previously created, £45,000, and after charging depreciation, £112,139; to special reserve account, £23,000; brought in, £35,026; preference dividend, £20,000; dividend on the ordinary shares of 6 per cent. for the year, £81,819; carried forward, £22,346.

Contracts Open

Johannesburg, March 26.—Six electric capstans, for the South African Railways and Harbours Board. The Department of Overseas Trade. (Reference A.Y. 12,221.)

Bognor Regis, March 2.—Pumping machinery, for the Urban District Council. Messrs. T. & C. Hawksley, civil engineers, 34, Old Queen Street, Westminster, S.W.1. (Fee £2 2s., returnable.)

South Africa, March 12.—Ten 4-ton electrically-driven portal jib cranes, for the South African Railways and Harbours Administration. The Department of Overseas Trade. (Reference A.Y. 12,230.)

Richmond, March 1.—40 tons of 7-in. dia. cast-iron pipes (or 800 yds. of spun pipes) and special castings, for the Richmond (Surrey) Town Council. Mr. H. P. Williamson, water engineer, Hotham House, Heron Court, Richmond, Surrey. (Fee £2, returnable.)

New Companies

Colesonia, Limited.—Capital £2,000. Sandblast and general industrial process finishers. Directors: E. Coles, 104, Penns Lane, Erdington, Birmingham; P. Coles.

Ely (Machines), Limited.—Capital £1,000. Machinery merchants, mechanical engineers and iron-founders, etc. Subscriber: G. H. Taylor, Finsbury Court, Finsbury Pavement, E.C.

National Federation of Iron and Steel Manufacturers

(*Concluded from page* 152)

pursued and would be progressively developed. It was their firm determination to ensure that the industry should be restored to a profit-earning basis. They believed that, quite apart from their own interests, an industry or an enterprise which continued to operate at a loss was of necessity a centre of weakness in the body politic. On the other hand, the fear of monopoly and its consequences must vanish when it was remembered that a basic industry, such as theirs, depending as it did for its profitable operation on the full time employment of a very costly plant, could not possibly raise the price level of its products above that consistent with increasing consumption. Any reduction in output brought so swift a Nemesis on the industry concerned as to turn a profit immediately into a loss.

Concluding, the speaker said it would be idle to claim that all those concerned in the group of industries which he represented viewed with equal favour the proposals which they had adopted in principle that day. This would be too much to expect, but he could and did claim for the industry that they were all united in the acceptance of the principle that they could not prosper individually unless the industry as a whole was prosperous. Therefore, they were determined that with due regard to the interests, for which they were particularly responsible, they would make their contribution to the success of a national policy which in securing prosperity for the iron and steel industry would make a not unimportant contribution to national economic recovery.

The toast of "Our Guests" was proposed by MR. JOHN CRAIG (Past-President), and was coupled with the name of the Hon. Oliver Stanley (Minister of Transport).

The MINISTER OF TRANSPORT, responding to the toast, said he realised as well as anybody else that the iron and steel industry was one of the biggest users of transport in the country. At the same time it had to be recognised that transport was one of the biggest users in the country of iron and steel, and therefore the prosperity of the two was interdependent. Depression in the one meant depression in the other, although it had to be recognised, continued the speaker, that the conditions which created prosperity in the past had gone and the new conditions of to-day must be met by new methods. No amount of longing for the past would ever bring it back. Nobody could say whether the times in front of us would be better or worse; all we could say with certainty was that they would never be the same times, and what we had to do was not to try to fit facts to old theories but to try to fit theories to the new facts.

The final toast of "The Chairman" was proposed by MR. A. J. GRANT and briefly acknowledged.

Obituary

THE DEATH OCCURRED, at his residence in Moray Park, Glasgow, on February 20, of Mr. Alexander Fraser Dunsmore, a director of Messrs. Watson Laidlaw & Company, Limited, engineers and iron-founders, Glasgow. Mr. Dunsmore, who was 69 years of age, was a native of Glasgow, served his apprenticeship with Messrs. A. & W. Smith, Limited, and was a draughtsman with the Mirrlees Watson Company, Limited. He joined the staff of Messrs. Watson Laidlaw & Company, Limited, more than 40 years ago, and became a director in 1924, and was mainly concerned with the technical side of the firm's business.

Notes from I.B.F. Branches

Scottish Branch.—The competitions under the John Surtees Memorial, founded by the late Mr. W. Mayer, a Past-President of the Institute of British Foundrymen, have this year been held in the Scottish area. In the junior grade, which is open only to apprentices in the foundry trade, there were 37 entries, the largest number ever received from Scottish members. In the senior grade four candidates entered. The medals and prizes will be presented to the successful candidates at the annual business meeting of the Scottish Branch, on March 10, by Sir Arthur J. C. Huddleston, C.M.G., O.B.E., M.A., the Director of the Royal Technical College, Glasgow.

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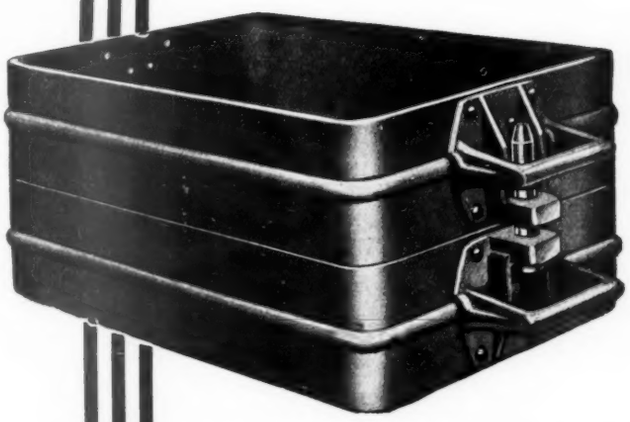

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Raw Material Markets

Business in the iron and steel markets has, to a certain extent, been hampered by the uncertainty arising from the recent price increases and last week's meeting of the National Federation of Iron and Steel Manufacturers. At the latter meeting, the scheme for the reorganisation of the industry was provisionally approved, and a final draft is to be presented for acceptance later on. New orders for pig-iron are not very numerous at the moment, but heavy tonnages are being taken out under existing contracts, and the producers are satisfactorily placed for work for some time ahead.

Pig-Iron

MIDDLESBROUGH.—There continues to be a heavy call for Cleveland foundry iron, and consumers' demands are barely met by the present output. In view of the circumstances, very little iron is being sent abroad. The present tightness of the market is likely to continue for some while, as raw-material prices remain very high and the ironmasters show no sign of making an early increase in output. The fixed minima for No. 3 Cleveland G.M.B. quality are 67s. 6d. per ton delivered in the Middlesbrough area, 69s. 6d. delivered to other North-East Coast destinations, 67s. 3d. delivered Falkirk and 70s. 3d. delivered Glasgow. No. 1 foundry iron is quoted at 2s. 6d. per ton more than No. 3 G.M.B., while No. 4 foundry iron and No. 4 forge are 1s. per ton less. There are no fixed export prices.

Owing to the large increase in the output of East Coast hematite, the market is much weaker and there is some irregularity in prices, although the latter still stand nominally at 67s. 6d. per ton for mixed numbers and 68s. for No. 1 grade, f.o.t. makers' works. It is possible to buy at slightly less. Most of the makers, of course, are already heavily booked for some months ahead. Export business is poor, and it is stated that the effort to fix a minimum price for overseas trade has been frankly abandoned. It is understood that a system of "zone" prices for the home trade is being adopted by the makers.

LANCASHIRE.—New pig-iron business is of rather limited volume, and it is not expected that full activity will be seen much before the end of March. In the meantime, Lancashire foundries are taking fairly satisfactory quantities of iron under current contracts. Values are firmly maintained all round, offers of Derbyshire, Staffordshire and North-East Coast brands of No. 3 foundry iron all being made on the basis of 72s. per ton, with Northants at 70s. 6d., Derbyshire forge at 67s. and Scottish foundry at about 85s. East Coast hematite is being offered for delivery Manchester or equal at around 80s. per ton, but there are reports of merchants underselling a little, whilst West Coast hematite continues to be quoted at about 81s.

MIDLANDS.—The market has evidently not yet adjusted itself to the increased iron prices, and the volume of new business is limited, orders being confined to small transactions with those consumers who continue to buy from hand to mouth. Generally speaking, however, satisfactory delivery orders are being received by the ironmasters in connection with current contracts. The minimum Association prices applicable to Birmingham and Black Country stations are 67s. 6d. for Northants No. 3 and 71s. per ton for Derbyshire, Lincolnshire and North Staffordshire No. 3. These figures are subject to rebate in certain cases. With regard to iron for the general engineering trade, there is no control, but prices have stiffened somewhat, and medium-phosphorus irons are now 75s. to 82s. 6d. per ton, with low-phosphorus from 82s. 6d. to 90s., delivered this area. No change has been made in refined pig, which is quoted between £5 15s. and £6 15s. per ton. The present price for Scottish No. 3, of which moderate quantities are consumed locally, is round about 87s. 6d. per ton.

SCOTLAND.—Generally quiet conditions prevail in the Scottish pig-iron market, many users having entered into contracts before the rise in prices took place. No. 3 Scottish foundry iron is now 70s. per ton, f.o.t. furnaces, with 2s. 6d. per ton extra for No. 1. The light-castings founders, particularly in the Falkirk area, remain very busy, full-time working being the rule. No. 3 Middlesbrough is quoted at 67s. 3d. f.o.t. Falkirk and 70s. 3d. f.o.t. Glasgow, other English irons being 1s. 3d. per ton less. Some firms have found difficulty in securing prompt supplies of Cleveland iron.

Coke

Although still unchanged, coke prices are very firm, and the makers are not prepared to book beyond June. For delivery in the South Staffordshire area, quotations are as follow:—Best Durham foundry coke, 36s. 6d. to 40s.; Welsh, 36s. to 47s.; Scottish coke, 40s. to 41s. per ton.

Steel

Steady rather than active conditions rule, and the volume of business is not so large as during January. In part this may be due to the heavy buying by consumers in anticipation of the advances in prices which later occurred. The works in most sections of the trade are well supplied with orders, and so far specifications against contracts have come forward regularly. In the semi-finished steel department, there is steady pressure for delivery on the part of consumers, and although current business is not on the scale of a few weeks ago, large amounts are passing into consumption. Continental competition is negligible in this department, as the prices for foreign semis are practically the same as for British material. Business in finished steel is irregular, and in one or two sections the demand has declined. In others, however, the works are operating on a good scale, and fresh business is coming forward at a satisfactory rate.

Scrap

There is a good demand for scrap iron in the Cleveland area, partly as the result of expectations of a further rise in prices. Ordinary metal is at about 55s. and machinery at 57s. 6d. A steady demand exists in the Midlands, where machinery metal is quoted at 55s., good heavy pipe and plate scrap at 50s., and clean light metal at 47s. 6d., all delivered works. In Scotland, machinery scrap is firm at about 58s. 6d., ordinary cast iron, in pieces suitable for cupolas, being at 55s. The market remains sluggish in South Wales, where the demand for cast-iron scrap is limited.

Metals

Copper.—Quotations in the copper market, after showing a fairly firm tone last week, fell back slightly on Monday to £32 10s. per ton for standard metal. There has been little or no change in general conditions, the selling pressure from America in the electrolytic market being maintained, owing to the exchange position. The latter continues to exercise considerable influence upon the situation. A recent feature has been the strong demand for copper from German consumers, particularly cathodes and wire bars, the latter for cablemaking.

The week's prices have been as follow :—

Cash.—Thursday, £33 2s. 6d. to £33 3s. 9d.; Friday, £33 to £33 1s. 3d.; Monday, £32 10s. to £32 11s. 3d.; Tuesday, £32 7s. 6d. to £32 8s. 9d.; Wednesday, £32 11s. 3d. to £32 12s. 6d.

Three Months.—Thursday, £33 6s. 3d. to £33 7s. 6d.; Friday, £33 3s. 9d. to £33 5s.; Monday, £32 15s. to £32 16s. 3d.; Tuesday, £32 11s. 3d. to £32 12s. 6d.; Wednesday, £32 16s. 3d. to £32 17s. 6d.

Tin.—Demand from consumers has broadened a little, both in this country and on the Continent, and rather more active conditions have at the same time been reported from the United States of America. The market generally presents a somewhat firmer appearance, with buyers disposed to take a more active interest; in consequence, offerings, which at times have been substantial, have been readily absorbed. On the whole, rather more favourable reports have emanated from America, where trade conditions have been more satisfactory and consumption is believed to be improving; it is assumed, therefore, that there will in the near future be a better inquiry for tin, and particularly so having in view the quiet demand which has prevailed for some weeks, and which must have caused some considerable depletion of consumers' stocks. With confidence gradually returning, therefore, some further advance might reasonably be anticipated, state Messrs. Rudolf Wolff in their weekly report.

Daily quotations :—

Cash.—Thursday, £228 2s. 6d. to £228 5s.; Friday, £228 2s. 6d. to £228 5s.; Monday, £227 12s. 6d. to £227 15s.; Tuesday, £227 2s. 6d. to £227 5s.; Wednesday, £227 12s. 6d. to £227 17s. 6d.

Three Months.—Thursday, £227 17s. 6d. to £228; Friday, £227 15s. to £227 17s. 6d.; Monday, £227 5s. to £227 10s.; Tuesday, £226 17s. 6d. to £227; Wednesday, £227 2s. 6d. to £227 7s. 6d.

Spelter.—The demand for spelter from actual manufacturers has not been very brisk lately, and dealings on the London Metal Exchange have been principally of a professional nature. A rather weaker tone in quotations has been seen.

Price fluctuations :—

Ordinary.—Thursday, £14 18s. 9d.; Friday, £14 17s. 6d.; Monday, £14 15s.; Tuesday, £14 13s. 9d.; Wednesday, £14 15s.

Lead.—The demand from consumers has been only moderate and rather irregular. In America the statistics for January show that stocks have increased by about 4,500 short tons, and now amount to over 207,000 short tons, which is a new high record. This has occurred in spite of a fall in production, and shows that consumption is still lagging behind, report Messrs. Brandeis, Goldschmidt.

Daily market prices :—

Soft Foreign (Prompt).—Thursday, £11 15s.; Friday, £11 15s.; Monday, £11 12s. 6d.; Tuesday, £11 12s. 6d.; Wednesday, £11 12s. 6d.

Correspondence

(*Concluded from page* 144)

with internal cores can be cast far too quickly, and when this occurs, the expanding gases generated during casting operations not having got away sufficiently quickly through the vents, must take the least line of resistance, and this is through the steel in the mould; and people who are conversant with the production of steel castings know that, if a "blow or kick" occurs, particularly where sections are thin, the steel never gets back again to fill up the spaces created by the eruption due to the quick solidification of the steel; the more so if the mould and core should happen to be cold before casting began.

Hot Mould Practice

Quite often, to close a mould ready for casting, and then return it to the stove to get heated up again is good practice, but I doubt if this would be possible with an oil-sand core. This ensures a more uniform solidification, a more homogeneous steel, and also cuts out the chance of any chilling of the casting where such should not take place, as when casting in cold moulds; and, more particular still, the hot mould could be run at a slower rate, thereby giving the gases all the more chances to get away before the mould is full of steel. It also minimises the chances of a misrun casting. For the proof of moulds with internal cores being filled too quickly, and being subsequently wasters, is the fact that moulds run at a much slower rate, and everything else being identical, were quite sound, and the chances of "misruns" were cut out by heating up the moulds after closing, and casting immediately after withdrawal from the stove. These cores were not oil-sand bonded. Cylindrical castings cast vertically, and a flange across the top which needed a feeding head, were found to be very porous when the head was cut off. An oil-sand core was used with only the vent open at the bottom end, steel covering the core elsewhere. To overcome this it was found that the oil-sand core was the trouble, and to overcome this sponginess, or porosity, in the casting directly under the feeding head, oil sand was left out for the top 8 in. of the core, composition being used instead; and directly over the vent a steel chill was inserted to ensure that all possible obstruction was put in the way of any gases coming through the top of the core this time. The result justified what was done, which proves that oil sand can be used where it should not and needs judgment before using.

Yours, etc.,

Sheffield. Walter Barker.

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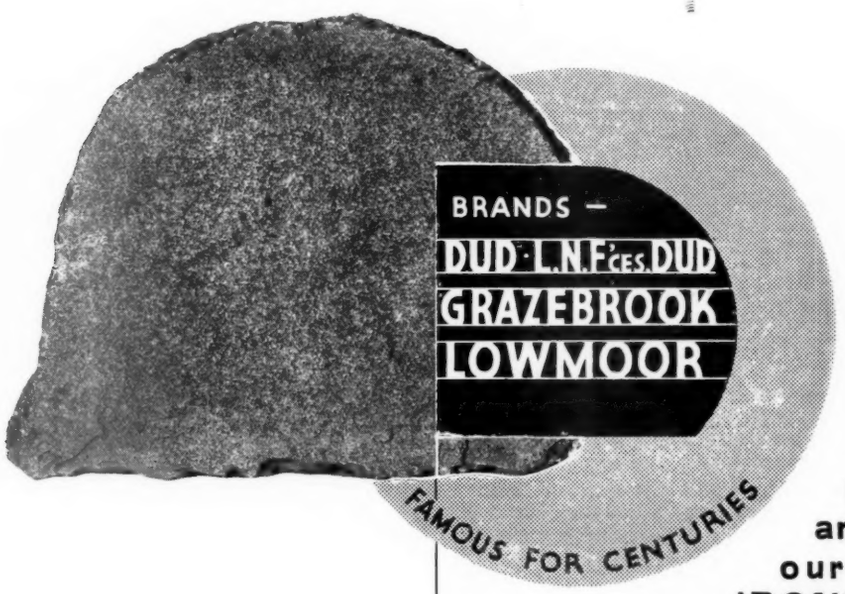

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RAW MATERIALS—PRICE LIST

(Wednesday, February 28, 1934)

COPPER

	£	s.	d.
Standard cash	32	11	3
Three months	32	16	3
Electrolytic	35	10	0
Tough	34	5	0
Best selected	34	15	0
Sheets	62	0	0
India	44	0	0
Wire bars	35	15	0
Ingot bars	35	15	0
H.C. wire rods	38	5	0
Off. av. cash, January	32	12	0 9/44
Do., 3 mths., January	32	14	8 21/44
Do., Sttlmnt., January	32	12	1 10/11
Do., Electro, January	35	18	6 3/11
Do., B.S., January	35	9	8 3/11
Do., wire bars, January	36	4	9 3/11
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			6½d.

BRASS

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8¾d.
Rods, extd. or rlld.	4½d.
Sheets to 10 w.g.	7½d.
Wire	7¾d.
Rolled metal	7d.
Yellow metal rods	4¼d.
Do. 4 × 4 Squares	5¼d.
Do. 4 × 3 Sheets	5¾d.

TIN

	£	s.	d.
Standard cash	227	12	6
Three months	227	2	6
English	228	5	0
Bars	229	15	0
Straits	231	12	6
Australian (nom.)			—
Eastern	231	5	0
Banca	231	12	6
Off. av. cash, January	226	14	3 9/11
Do., 3 mths., January	226	15	8 3/11
Do., Sttlmt., January	226	14	1 1/11

SPELTER

	£	s.	d.
Ordinary	14	15	0
Remelted	14	10	0
Hard	11	15	0
Electro 99.9	16	15	0
English	15	5	0
India	13	10	0
Zinc dust	20	0	0
Zinc ashes	3	5	0
Off. aver., January	14	16	3 5/22
Aver. spot, January	14	13	9

LEAD

	£	s.	d.
Soft foreign ppt.	11	12	6
Empire	11	17	6
English	13	0	0
Off. average, January	11	8	2 23/44
Average spot, January	11	6	0 21/22

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex-whse.	23	2	6
Rods	29	0	0

ANTIMONY

	£	s.	d.
English	37 10 0 to 40	0	0
Chinese, ex-whse.	28	0	0
Crude	20	0	0

QUICKSILVER

Quicksilver .. 10 5 0 to 10 12 6

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	8 17 6
45/50%	13 0 0
75%	18 2 6
Ferro-vanadium—	
35 50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	2/6 lb.
Tungsten metal powder—	
98/99%	2/9 lb.
Ferro-chrome—	
2/4% car.	32 0 0
4/6% car.	23 0 0
6/8% car.	21 12 6
8/10% car.	21 12 6
Ferro-chrome—	
Max. 2% car.	37 10 0
Max. 1% car.	38 15 0
Max. 0.70% car.	42 0 0
70% carbon-free	10½d. lb.
Nickel—99.5/100%	£225 to £230
"F" nickel shot	£202 10 0
Ferro-cobalt, 98/99%	5/6 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten 2s. 0d.
Finished bars, 18% tungsten 2s. 9d.
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares, 3 in. and over 4d. lb.
Rounds and squares, under ½ in. to ¼ in. 3d. lb.
Do., under ¼ in. to 1/16 in. 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in. 3d. lb.
Do., under ½ in. × ¼ in. 1/- lb.
Bevels of approved sizes and sections 6d. lb.
Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	2	15	0 to	2	16	0
Bundled steel and shrngs.	2	7	6 to	2	15	0
Mixed iron and steel	2	10	0 to	2	12	6
Heavy cast iron	2	7	6 to	2	8	6
Good machinery	2	7	6 to	2	10	0
Cleveland—						
Heavy steel				2	10	0
Steel turnings				1	17	6
Cast-iron borings				1	8	9
Heavy forge				2	10	0
W.I. piling scrap				2	5	0
Cast-iron scrap	2	15	0 to	2	17	6
Midlands—						
Light cast-iron scrap				2	7	6
Heavy wrought iron				3	0	6
Steel turnings, f.o.r.				1	12	6
Scotland—						
Heavy steel	2	12	6 to	2	13	6
Ordinary cast iron				2	15	0
Engineers' turnings				2	1	6
Cast-iron borings				2	0	0
Wrought-iron piling				2	12	6
Heavy machinery				2	18	6

London—Merchants' buying prices, delivered yard.

Copper (clean)	28	0	0
Brass	20	0	0
Lead (less usual draft)	10	10	0
Tea lead	8	0	0
Zinc	10	0	0
New aluminium cuttings	68	0	0
Braziery copper	26	0	0
Gunmetal	26	0	0
Hollow pewter	150	0	0
Shaped black pewter	105	0	0

PIG-IRON

(f.o.t. unless otherwise stated)

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/-
Foundry No. 3	67/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1, f.o.t.	68/-
Hematite M/Nos., f.o.t.	67/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/-
,, No. 3 fdry.	71/-
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/-
,, fdry. No. 3	71/-
,, fdry. No. 1	74/-
Scotland—	
Foundry No. 1	72/6
,, No. 3	70/-
Hem. M/Nos. d/d	71/-
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
E.C. hematite	81/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	72/-
Staffs fdry. No. 3	72/-
Northants fdry. No. 3	70/6
Cleveland fdry. No. 3	72/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	85/-
Clyde, No. 3	85/-
Monkland, No. 3	85/-
Summerlee, No. 3	85/-
Eglinton, No. 3	85/-
Gartsherrie, No. 3	85/-
Shotts, No. 3	85/-

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	12	6 to	9	15	0
Nut and bolt iron	7	5	0 to	7	15	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.				13	15	0
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	5	0 to	9	0	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ⅜ in. (Untested)				8	12	0
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates	12	0	0 to	12	10	0
Hoops (Staffs)	10	10	0 & up.			
Black sheets, 24g. (4-t. lots)				10	5	0
Galv. cor. shts. (,,)				12	15	0
Galv. flat shts. (,,)				13	5	0
Galv. fencing wire, 8g. plain				14	0	0
Billets, soft				5	10	0
Billets, hard	6	17	6 to	7	2	6
Sheet bars	5	0	0 to	5	5	0
Tin bars				5	0	0

PHOSPHOR BRONZE

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	11⅞d.
Rods	11d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	19.26
No. 2 foundry, Valley	17.50
No. 2 foundry, Birm.	13.50
Basic, Valley	17.00
Bessemer	19.76
Malleable, Valley	17.50
Grey forge, Valley	17.50
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	26.00
Sheet bars	26.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	1.89
Steel bars	1.75
Tank plates	1.70
Beams, etc.	1.70
Skelp, grooved steel	1.60
Steel hoops	1.85
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.85
Wire nails	2.35
Plain wire	2.20
Barbed wire, galv.	2.85
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 27/6
,, furnace	18/6 to 19/-
Durham foundry	21/- to 25/-
,, furnace	18/-
Midlands, foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		16/3 to 16/6
,,	28×20	,,	32/6 to 33/-
,,	20×10	,,	23/6 to 23/9
,,	18⅞×14	,,	17/-
C.W.	20×14	,,	15/-
,,	28×20	,,	31/- to 31/3
,,	20×10	,,	21/6 to 21/9
,,	18⅞×14	,,	15/- to 15/3

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£6	0	0 to	£7	0	0
Bars-hammered, basis	£16	0	0 to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0 to	£16	0	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£30	0	0 to	£31	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.	
Feb.	22 ..	33	2	6	inc. 2/6
,,	23 ..	33	0	0	dec. 2/6
,,	26 ..	32	10	0	,, 10/-
,,	27 ..	32	7	6	,, 2/6
,,	28 ..	32	11	3	inc. 3/9

Electrolytic Copper

		£	s.	d.	
Feb.	22 ..	36	0	0	No change
,,	23 ..	35	15	0	dec. 5/-
,,	26 ..	35	10	0	,, 5/-
,,	27 ..	35	0	0	,, 10/-
,,	28 ..	35	10	0	inc. 10/-

Standard Tin (cash)

		£	s.	d.	
Feb.	22 ..	228	2	6	inc. 12/6
,,	23 ..	228	2	6	No change
,,	26 ..	227	12	6	dec. 10/-
,,	27 ..	227	2	6	,, 10/-
,,	28 ..	227	12	6	inc. 10/-

Tin (English ingots)

		£	s.	d.	
Feb.	22 ..	228	15	0	inc. 15/-
,,	23 ..	228	15	0	No change
,,	26 ..	228	5	0	dec. 10/-
,,	27 ..	227	15	0	,, 10/-
,,	28 ..	228	5	0	inc. 10/-

Spelter (ordinary)

		£	s.	d.	
Feb.	22 ..	14	18	9	inc. 1/3
,,	23 ..	14	17	6	dec. 1/3
,,	26 ..	14	15	0	,, 2/6
,,	27 ..	14	13	9	,, 1/3
,,	28 ..	14	15	0	inc. 1/3

Spelter (Electro, 99.9 per cent.)

		£	s.	d.	
Feb.	22 ..	17	0	0	No change
,,	23 ..	17	0	0	,, ,,
,,	26 ..	16	15	0	dec. 5/-
,,	27 ..	16	15	0	No change
,,	28 ..	16	15	0	,, ,,

Zinc Sheets (English)

		£	s.	d.	
Feb.	22 ..	24	10	0	No change
,,	23 ..	24	10	0	,, ,,
,,	26 ..	24	10	0	,, ,,
,,	27 ..	24	10	0	,, ,,
,,	28 ..	24	10	0	,, ,,

Lead (English)

		£	s.	d.	
Feb.	22 ..	13	0	0	No change
,,	23 ..	13	0	0	,, ,,
,,	26 ..	13	0	0	,, ,,
,,	27 ..	13	0	0	,, ,,
,,	28 ..	13	0	0	,, ,,

A COMPARISON OF SCRAP PRICES

Prices of Heavy Steel Scrap (Delivered) in the Principal Districts at the Beginning of Each Month in the Years 1929–1934.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Scotland—													
1929	3 5 6	3 7 6	3 12 6	3 15 0	3 15 0	3 15 0	3 15 6	3 16 0	3 17 6	3 15 0	3 12 6	3 10 6	3 13 1½
1930	3 9 0	3 7 6	3 5 0	3 5 0	3 0 6	2 15 0	2 12 0	2 10 0	2 13 3	2 10 0	2 10 0	2 10 0	2 17 3½
1931	2 7 6	2 7 6	2 5 0	2 5 0	2 0 0	1 17 6	1 17 6	1 17 6	1 17 6	1 15 0	2 0 0	2 2 6	2 1 0½
1932	2 2 6	2 2 6	2 0 0	1 17 6	1 17 6	1 17 6	1 15 0	1 15 0	1 12 6	1 13 0	1 12 6	1 15 0	1 16 9½
1933	1 15 0	1 17 6	1 18 6	1 18 9	1 18 0	1 17 6	1 18 9	2 0 0	2 2 6	2 5 0	2 7 6	2 8 9	2 0 7½
1934	2 8 9	2 14 3	—	—	—	—	—	—	—	—	—	—	—
North-East Coast—													
1929	3 0 0	3 2 6	3 3 6	3 3 6	3 3 6	3 5 0	3 5 0	3 5 0	3 5 0	3 6 6	3 5 0	3 3 6	3 4 0
1930	3 3 6	3 3 6	3 2 0	3 0 0	2 17 6	2 10 0	2 10 0	2 7 6	2 7 6	2 7 6	2 5 0	2 6 0	2 13 4
1931	2 6 0	2 6 0	2 5 0	2 5 0	2 2 6	2 0 0	1 17 6	1 17 6	1 17 6	1 17 6	1 17 6	2 2 6	2 1 2½
1932	2 0 0	2 0 0	1 15 0	1 15 0	1 15 0	1 15 0	1 15 0	1 15 0	1 15 0	1 12 6	1 15 0	1 17 6	2 15 10
1933	2 0 0	2 0 0	2 5 0	2 0 0	1 15 0	1 17 6	2 2 6	2 2 6	2 3 6	2 5 0	2 7 6	2 7 6	2 2 2
1934	2 10 0	2 16 0	—	—	—	—	—	—	—	—	—	—	—
South Wales—													
1929	3 8 6	3 10 6	3 15 0	4 0 0	4 0 0	3 18 0	3 17 6	3 17 6	3 15 0	3 15 0	3 12 6	3 7 6	3 14 9
1930	3 7 6	3 6 0	3 6 0	3 4 0	3 2 6	2 17 6	2 16 0	2 15 0	2 14 9	2 12 6	2 12 6	2 5 0	2 18 3½
1931	2 5 0	2 7 6	2 7 6	2 7 6	2 5 0	2 2 6	2 0 0	2 0 0	1 18 0	2 2 6	2 5 0	2 7 6	2 4 0
1932	2 6 6	2 6 0	2 5 0	2 2 6	2 2 0	1 19 0	1 17 6	1 18 6	1 18 0	1 18 0	1 17 6	1 18 0	2 0 8½
1933	2 0 0	2 1 6	2 4 0	2 3 6	2 3 6	2 3 0	2 5 0	2 5 0	2 8 0	2 10 0	2 10 0	2 10 0	2 5 3¼
1934	2 10 0	2 16 3	—	—	—	—	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG REGISTERED TRADE MARK LIMPET IRON

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

Notice

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

ADVERTISER, well established among ironfounders with travelling Midland Counties and Lancashire, is desirous of selling pig-iron for a blast-furnace company.—Address, Box 654, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ASSISTANT Chemist and Metallurgist (age 20-25) required by large plant in Eastern Counties. Must be quick and accurate analyst. Knowledge of ironfoundry practice essential, and of non-ferrous an advantage.—Write, stating full particulars of experience and salary expected, to "A. S.," c/o J. W. VICKERS & COMPANY, LIMITED, 24, Austin Friars, London, E.C.2.

REQUIRED for foundry, South of England, Metal Pattern-Plate Moulder used to French system.—Apply, stating age, wages and full particulars to Box 676, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

YOUNG Metallurgical Chemist required as Assistant Chemist in foundry laboratory. Must be used to ferrous and non-ferrous analysis.—Apply, stating age, salary required and previous experience, to Box 678, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOREMAN Patternmaker desires re-engagement. Has had experience in similar capacity with well-known firms making light repetition castings for the motor and electrical trades. Specialist on machine and platework. (238)

AGENCY

AGENCY required, Eastern and Southern Counties, for Sheffield Ganister. Large connection for right material.—Details and prices to Box 672, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

BUSINESSES FOR SALE AND WANTED

WANTED Purchase, established Pig-iron Merchant's Business, preferably one with promising export connections.—Full details in strict confidence, Box 670, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

OLD-ESTABLISHED Steel-Foundry Business in Sheffield for Sale as a Going Concern; consistent record of profit; genuine reasons for retirement.—Apply to J. W. BEST & COMPANY, Chartered Accountants, St. Peter's Close, Sheffield.

PARTNERSHIP

PARTNER required with £150 to invest, or would sell, small non-ferrous foundry; increasing trade; close to City.—Write, C. R. DODD, 2 and 3, Hind Court, Fleet Street, London, E.C.

PATENTS

Form P. Amendt. 2.

PATENTS AND DESIGNS ACTS, 1907 TO 1932.

NOTICE is hereby given that Edwin Hardwick Moore, of Botts Green Hall, Over Whitacre, near Coleshill, Warwickshire, seeks leave to amend the specification of the application for Letters Patent No. 400,121 for an invention entitled "Improvements Relating to the Manufacture of Aluminium Alloys."

Particulars of the proposed amendment were set forth in No. 2,353 of the Official Journal (Patents), published on February 21, 1934.

Any person, or persons, may give Notice of Opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton Buildings, London, W.C.2, within one calendar month from the date of publication of the said Journal.

M. F. LINDLEY,
Comptroller-General.

PATENTS AND DESIGNS ACTS, 1907 TO 1932.

NOTICE is hereby given that Thos. W. Robinson, Limited, of Dennis Park Iron Works, Stourbridge, Worcestershire, and Walter Victor Paget, of the company's address, seek leave to amend the Complete Specification of the Application for Letters Patent No. 398,956 for an invention entitled "An Improved Method of and Means for Casting Rain-water Pipes and other Symmetrical Metal Articles."

Particulars of the proposed amendment were set forth in No. 2,352 of the Official Journal (Patents), published on February 14, 1934.

Any person, or persons, may give Notice of Opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton Buildings, London, W.C.2, within one calendar month from the date of publication of the said Journal.

M. F. LINDLEY,
Comptroller-General.

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1934 edition now ready. Price 42s. cloth bound, 52s. morocco. Order *YOUR* copy *NOW*.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY

SANDBLAST PLANTS

Room, Rotary Barrel and Cabinet Types complete; 12 in stock.

SAND PLANT

Sand Mills, 6-ft., 5-ft. and 4-ft. 6-in. dia. Pans.

Rotoil "Senior" Oil Core Sand Mixer.

Pneulec Sand Drying Plant, output 1 ton per hour.

Brearley Type Disintegrators.

MOULDING MACHINES

Hand and Pneumatic Types.

Also

Six Rowlands Double-ended Grinders for 24-in. dia. x 2-in. wheels.

Electrical and Belt-driven Blowers and Exhaust Fans, Ladles, etc., etc.

AIR COMPRESSORS

All sizes for high and low pressures.

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'Phone: Broadwell 1359.

MACHINERY—*Continued*

THOS. W. WARD, LTD.

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